THE

ELECTRICAL REVIEW.

VOL. XXXII. MARCH 24, 1893. No. 800

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THE TELEPHONE QUESTION.

WHEN we protested against the *Standard's* article, we had no idea that the telephone question would form the title of an article in our columns in each alternate issue; but contemporaries have sought to throw doubts upon the accuracy of our statements, and as the subject is not generally known, there are advantages in a controversy which by questioning conclusions assists in making the facts clear.

The *Electrical Engineer* very properly desired a definition of terms, and intimated that if the Law and the Mann systems were identical, its case was gone. We therefore limited our remarks on this point in our last article to a proof of this identity. Our contemporary, without expressing assent or dissent to the question of identity as a fact, now raises (in order to "bring us back to the original position") a different issue, viz., what has been the common understanding in reference to the two systems?

Our contemporary does well to raise the further issue. It has a practical bearing, and will help us in arriving at the goal we are both aiming for—"to get facts, and to get at the truth."

We should have been glad to think that the first question was out of the way, but our contemporary is, apparently, not quite satisfied. It quotes all the authorities we quoted in our article, and says: "We hardly know where to look for authorities to put against these," and then proceeds to refer to the patent specifications we also quoted, arriving at an admission that "an American patent *may* contain the modification known here as the Mann"—rather a halting admission of an historical fact. History must not be left in doubt, so we will add to what we have already published an extract from a circular with which we have been favoured. It is:—"A description of the Telephone Exchange System of the Law Telegraph Company, of New York," issued in 1880:—

"The calling wire may be either a metallic or a ground circuit, although the former is preferable, and it should 'loop back' into the central office frequently, so that in time of 'trouble' the 'trouble' can be immediately located to a particular loop and quickly found and removed. This 'looping back' is without any material waste of wire, because subscribers are always so numerous near the central office that both 'legs' of each loop can be used advantageously.

"The call wire may either 'loop' into each subscriber's office, or it may 'branch' in. The former is preferable in large or active exchanges and with more than 50 in a circuit, and the latter in small exchanges and with but a few on a circuit, but both plans are sometimes advantageous for different circuits from the same central office. . . . . Orders are given and received between different central offices connected by trunk lines, in the same manner as between the central offices and the subscribers, that is, by call wires and listening operators.

"Under this plan the Law Telegraph Company, who are operating five central offices, establish communication between a subscriber connected with one office and a subscriber connected with another office almost as quickly as between the two subscribers, both of whom are connected with the same office."

We hope our contemporaries will now be satisfied that on the first issue there is no need for further discussion. It was quite sufficiently established before; but this is direct evidence that the so-called Mann system (branch call wire), "invented in the spring of 1882," "established in Dundee late in the autumn of 1882"—not known "outside Dundee until 1885" (*vide* Mr. Mann's letter, ELECTRICAL REVIEW, November 13th, 1891, p. 575) was a part of the Law system in 1880.

With regard to the second issue: what has been the understanding when "Law" and "Mann" are spoken of? The *Electrical Engineer* says: "With the exception of the ELECTRICAL REVIEW, we imagine that it has been customary, in this country at any rate, to distinguish the 'Law' and the 'Mann' systems as being independent." To this we have to say that, so far as we are aware, it has never been customary to regard them as independent. The quotation which our contemporary, following our example, takes from "The Telephone" (Preece and Maier), and which describes the Mann as "a modification of the Law system," accurately describes what we believe to have been the general impression, and if our contemporary will turn to our first article on the subject (September 11th, 1891, p. 305), it will see that the ELECTRICAL REVIEW was no exception to the custom of distinguishing between the two, and, but for the efforts which were made to place the Mann system on a pedestal of its own, we should probably still be drawing a distinction. Investigation and inquiry became necessary, and we have evidence now that there is no difference at all. The Law system comprised a broad principle—the use of a circuit wire. It was a method of calling the exchange by voice and not by signal. It was therefore a "system," and recognised as such. The manner in which the circuit wire was run was a detail. A subscriber would not know whether his circuit wire was a main line with stations in series or a line with stations on branches—in other words, to the subscriber there is not the slightest difference between the Law system and the so-called Mann system, as they were previously understood. The difference is an engineering detail, and assuming that Mr. Mann had not been completely anticipated in that detail, his circuit wire could hardly be called a "system," although it had become customary to so call it, as our contemporary says. It was then supposed that the branched call wire had the merit of originality. Now that supposition is removed, and all who wish to be accurate must revert to the original name.

But we must not omit the practical bearings of the discussion. The object of our contemporaries is to show that we were incorrect in saying that the system proposed at the B.A. had been tried and failed. As we have already had to remind our contemporaries, the system proposed at the B.A. was made up of two parts—circuit wire system and numerous exchanges. The *Electrical Engineer* applies the word "failed" to the circuit wire only. We did not use it so; but we have no objection, for the purposes of discussion, to adopt it for the two parts separately, as well as for the combination. Our exact position on the circuit wire question is that of our first article, September 11th, 1891 (p. 306): "Numbers of exchanges have been fitted with it and have abandoned it." And here comes the importance of our contemporary's desire for a definition of terms. If those exchanges which have abandoned it have all been fitted with the main circuit wire, and none abandoned which have been fitted with the branched wire, it is obviously unfair to the so-called Mann system to include it—for purposes of practical discussion—with the Law, because everything may turn on the detail.

If our contemporary had perused our article in its entirety, it would not have taken the trouble to define a number of questions on this point, because it would have seen that the ground had already been thoroughly gone over, and the position accurately defined by us in the article to which we called attention. That article contains the following paragraph:—(ELECTRICAL REVIEW, November 13th, 1891, page 559)—"We said that numbers of exchanges had been fitted with the circuit wire system, and had abandoned it. This statement our correspondents have met with a very emphatic agreement as regards the Law, and an equally emphatic disagreement as regards the Mann. Our correspondents' conception of the Law circuit wire being a metallic loop, the view they hold is that the abandonment of the Law exchanges has been due to the use of the metallic loop, and that as no exchanges outside England have been called Mann exchanges, no exchange has been abandoned which was fitted with a main circuit wire having branches. That such an inference is an entirely mistaken one is now obvious," from evidence to which we referred.

Our contemporary will please note that we have not condemned the circuit wire system. We referred to a few obvious short-comings as a set-off to some of the extravagant claims urged for it. We regard the Law system (in which we of course include the so-called Mann system) as a very interesting example of telephony, but we say, and say distinctly, that the Law system (in which we include the so-called Mann system) has been established in many exchanges and has been abandoned. That it has not been abandoned in Dundee is nothing to the point. It exists to-day in far more important exchanges than Dundee, and there is no very strong evidence that the cities in which it continues to thrive are telephonic paradises. The fact is that the so-called Mann system has been known since the telephonic world began; it has been established and disestablished, the signal system being put in its place. We suggest no reasons and consider none. We take only the fact, and as we wrote on October 16th, 1891 (p. 464), "In the absence of proof to the contrary, we assume that experience teaches, and the fittest survives."

Lightning, in addition to asserting a difference between Law and Mann, argues on the question of the number of exchanges. To its observations, we may reply that Glasgow has the majority of its subscribers—probably more than two-thirds—connected to one exchange which serves the main business area; the minority—probably less than one-third—of the subscribers are divided between some five or six small exchanges situated in the outskirts. It is unnecessary to define elementary questions to show that *Lightning's* comparison with London is altogether beside the mark. On the question of numerous exchanges we express no opinion. We

deal only with facts. Numerous exchanges in limited areas were general; they are now exceptional.

These two features were combined in the system proposed by the New Telephone Company. We think it will not now be disputed that they are old; there is no question that they have been tried, and we must certainly decline to believe that they would have been abandoned in numerous instances and divers places unless they had failed. That was our contention on February 10th. It is our contention now. We shall be only too glad to find that the "causes of failure have been eliminated," but we must certainly add that "no evidence to that effect has been forthcoming" yet.

ELECTRIC SPARK PHOTOGRAPHS.

A report *in extenso* of the Edinburgh lecture of Mr. C. Vernon Boys, F.R.S., on electric spark photographs, is given in a recent issue of *Nature*, with illustrations of the latest results in bullet photography as developed by him. Mr. Boys, as an experimentalist, is always so successful, that we find ourselves instinctively expecting new wonders wherever his energies are focussed. He seems equally happy with bullet photography as with fibres, soap bubbles or integrating machines. It is evidently not from the elaborateness of his apparatus that he arrives at his successes, for that is generally of the simplest order; but it is his remarkable eye for physical conditions, his manipulative skill, to which is superadded the power of attacking problems which everybody else thought to be beyond them.

For the purpose of observing an object which is in rapid rotary or lateral motion, the method of apertures and flashes is comparatively old; the electric spark has often been used as a means of producing the required sudden illumination. Dr. Chichester Bell in his experiments on liquid jets avails himself of this method; Lord Rayleigh and Mr. F. J. Smith have also found it of service in various determinations of evanescent phenomena. The first experimentalist who succeeded in photographing a bullet *in transitu* was Prof. E. Mache of Prague, but to his work Mr. Boys has greatly added by simplifying the apparatus required and extending its results. The apparatus actually used by Mr. Boys is a device in which the bullet is made to close a subsidiary electrostatic circuit, consisting of a condenser of small capacity and a spark gap. When a spark passes across this gap, it, in turn, completes a second electrostatic circuit of a larger condenser and a special spark gap. This second and larger condenser, in discharging across its special spark gap, gives a bright and instantaneous flash, which acts upon the photographic plate. The bullet has at this moment a position between this bright point of light and the photo plate, which thus records the shadow of the bullet. The quantity of electricity discharged in the subsidiary circuit, by the moving bullet, is comparatively little, so that the spark at the bullet itself is too small to injure the photograph by direct action upon the plate. The auxiliary condenser is charged from the larger one by a wet string, which is a conductor while being used for this purpose. During the sudden *discharge*, however, the wet string behaves as a perfect insulator. This property of the wet string is of great service to Mr. Boys, as it enables him to concentrate the whole discharge of the larger condenser to the special spark gap.

The photographs are instructively interesting; they graphically represent many of the most important problems relating to the flight of projectiles. When a bullet is going at a rate *less* than the velocity of sound in air, there is seen upon the plate a perfectly defined image in a waveless medium, but when higher speeds are examined, there is evidence of a rippling of the air set up by the bullet fore and aft, and two distinct wave-fronts hurry into space, one proceeding from the head and the other from the tail of the missile. Each is shown in the photograph as a well defined line across the plate. Here is evidently a method for the determination of the velocity of sound.

That aerial ripples could be photographed does not at first suggest itself as a possibility, but there will be no difficulty in understanding why it should be so if we call to mind the shimmering appearance seen over a coke fire, or heated surface, in the sunshine. Here, there is an imperfect mixture of air of different densities, and the refraction which the incident light undergoes is different at each point, causing, here and there, positions of more or less darkness or brightness, depending, at each point, upon whether the direction in which the incident light happens to be deviated is to towards or away from the observer. Similarly the waves of compression which leave the bullet are able to show themselves on the photographic plate, owing to the increased density and consequent change in refractive index of the air where they are being propagated. By arranging reflectors at suitable positions, Mr. Boys has been able to illustrate "breakers" and he deduces important acoustical principles from them. Will he photograph a sound-wave for us?

To electricians a special point of interest is that the same apparatus here described may be used to show the order of sequence of two sparks which are discharged at times exceedingly near together. For the first spark heats the air at the gap, and the light of the second spark passing to the plate shows this heated space as a shadow on the film. The first spark to discharge in point of time is therefore the one whose shadow appears on the plate.

CABLE CONTRACTS.

The action brought by Henley's Telegraph Works Company against Mr. Ronald A. Scott, and reported by us elsewhere, presents many points of interest to contractors. The circumstances are briefly these:—

Mr. Scott, desiring to tender to the India Office for certain electrical goods, communicated with Henley's Company respecting the cables which were to be included in the tender, and a representative of the Henley Company accompanied a representative of Mr. Scott to the Admiralty Pattern Room, where patterns of the cables were to be seen. The patterns of cable were examined, and proved to be of a type which at that time was not manufactured by the Henley Company, viz., a jute insulation covered with lead.

It appears, however, that Mr. Scott desired Henley's to give him a price for these cables, together with prices of other materials of their manufacture, which had to be included in his tender for the India Office. The Henley Company then procured prices and samples for the jute and

lead cable from the Fowler-Waring Company, who were the makers of that type of cable, and in forwarding their quotation to Mr. Scott, advised him that they had sent him samples of the cables to be tendered for, which they asked him to submit to the Government authorities with his tender. The samples and prices are acknowledged by Mr. Scott, and subsequently he procured an order from the Government, the cable portion of which was placed with the Henley Company. The cables were made, the jute insulation cables being made for Henley's by the Fowler-Waring Company. Subsequently the various wires and cables under the contract were inspected at Henley's works by the Government electrician, who rejected that portion of the cables made by the Fowler-Waring Company, as not being in accordance with the specification.

There was a condition in the order placed by Mr. Scott with the Henley Company, that they were to be responsible in the event of rejection of the cables by the Government Inspector, and a similar condition was imposed by them on the Fowler-Waring Company with regard to their portion of the work.

Henley's Company refused to accept the rejection, but Mr. Scott, on the ground that they were responsible for the rejection under the condition of the order referred to above, would not accept the responsibility, and subsequently for the purpose of completing his order with the Government, purchased cable elsewhere at an enhanced price.

Henley's Company did not seek to shift the responsibility on to the Fowler-Waring Company, because they naturally considered that the rejection clause of the contract between themselves and Mr. Scott, and themselves and the Fowler-Waring Company, applied only to faulty manufacture, and not to the possibility of the cables being made under an entirely different specification to that required by the Government Department.

An action was therefore brought against Mr. Ronald Scott for the recovery of the invoice value of the cables, and he, on his part, claimed from the plaintiffs, Messrs. Henley, the difference between the price at which they invoiced the cables and the price he had to pay to another firm.

In the course of the trial it transpired that the cable was rejected because, instead of requiring a cable with jute insulation and lead, the Government requirement was for a cable with vulcanised India-rubber and lead. Mr. Potter, on behalf of the plaintiffs, stated that the patterns he examined at the pattern room were undoubtedly jute insulation, and counsel produced two specifications issued by the Admiralty, having identically the same pattern numbers, but one specifying jute cables, and the other vulcanised India-rubber.

The defendant said he showed a specification to Mr. Potter, which stated that the insulation was to be of vulcanised India-rubber. Mr. Potter denied having seen that specification, but evidence was given by Mr. Morris, keeper of the Admiralty Pattern Room, to the effect that no one could be admitted to the Pattern Room without submitting a specification to himself or one of his assistants, and he also made the extraordinary statement that the patterns exhibited were not necessarily in strict accordance with the specifications to which tenders were invited.

Now, it is interesting to notice two or three important facts which the trial has disclosed :—

1. That Government Departments appear to be in the habit of inviting tenders for goods to samples which are exhibited in their pattern rooms, which samples differ entirely with the specifications attached to the forms of tender.

2. That the Admiralty, having issued specifications for various kinds of cable, each cable having a certain number to identify it on the specification, subsequently saw fit to entirely change the specifications of the cables without changing the numbers.

The case was decided against Messrs. Henley. Like most litigants, we dare say they think they ought to have won it, and we are inclined to think so, too ; but the real cause of these traders spending their money on legal costs appears to us to be owing to some ignorance or negligence on the part of the Government authorities, who make new specifications without giving new pattern numbers, and who exhibit patterns in their rooms which are not in accordance with their specifications.

"Wilful Waste makes Woful Want."

Our city pages are unfortunately largely occupied with reports of company meetings of a very unsatisfactory nature to the shareholders. The consideration of the reports of committees of investigation and the appointment of other committees seems to be the order of the day. Woodhouse & Rawson United have decided upon voluntary liquidation on the understanding that proceedings against the directors are still open to the shareholders. Elmore's Patent Copper Depositing Company have appointed a committee of investigation, in spite of Mr. W. Elmore's assurance that they only wanted copper in order to make the business a success. The Elmore Wire Company wants something more than copper. It was stated that £3,000 must be provided to pay off the pressing creditors, pending the report of the committee, so that a company which was provided with a large capital and has frittered it away in a manner only to be described as wilful waste, is now in dire straits for a comparatively small sum. The French Elmore shareholders having had the opportunity of perusing the report of their committee and investigating expert have decided upon voluntary liquidation. They should peruse our article of January 16th, 1891. We hope that the various Elmore committees will pursue their enquiries thoroughly. The shareholders' loss has been considerable and entirely unjustified. If the committees can discover who has profited by the shareholders' losses, the information may be of interest.

Electric Illumination from Balloons.

Some extensive experiments have recently been made in connection with the German army, the object of which has been to provide continuous electrical illumination at night from balloons. The source of electricity was placed upon the ground, and the electric lamps were suspended from captive balloons. The illuminating power available was 5,000 candles. It was demonstrated that in misty weather a surface of about 500 metres diameter was well lighted from a height of 600 metres. From a height of 150 metres the cone of light was so directed as to thoroughly illumine one kilometre of road. These illuminators are stated to have given great satisfaction, and to be very easy to regulate and apply in any required direction. It is expected that they will prove particularly useful in siege operations, and are to be used for this purpose at the next manœuvres.

THE ELECTRIC LIGHT IN PUBLIC BUILDINGS.

BY ALFRED H. GIBBINGS.

IT is a most noticeable feature in many public buildings fitted with the electric light, that the installations have every appearance of being merely of a temporary nature.

This feature, indeed, is sufficiently obvious to appeal to the observation of any ordinary person who has occasion to frequent such places as museums, public libraries, large blocks of business offices, &c., and it is likely enough to give rise to the reflection that a serious want of confidence is still shown towards this method of illumination on the part of those who, nevertheless, have adopted it. The most conspicuous and prominent characteristics which immediately strike the attention, and which in themselves seem to suggest that the arrangement must be only of a tentative or temporary character, and almost appeal to be pardoned on that account, may be stated to be as follows:—

First.—The running of the casing on the exterior of the walls and ceilings. This is assuredly inelegant enough in itself, but the casing is often of a meagre description, and entirely out of harmony with the surrounding decorations.

Second.—The want of general arrangement and adequate effect, which results principally from an incorrect, because exaggerated, estimate, which assigns too large an area per light for its illuminating power.

Third.—The unseemly compromise which still widely exists between the adoption of the light pure and simple and the retention of the previous gas fittings. We do not here refer to those cases in which existing gas fittings are partially turned into electroliers and thus made to serve the two-fold purpose, but rather to the introduction of single electric lights, which constitute an offence to the eye as they hang by twisted flexible leads among the unused and heavy-looking gasoliers.

Referring again to the first characteristic we have mentioned, we are prepared to recognise that the great expense of renewal which would attach to any interference with, or alteration in the nature and style of the decorations, may be urged in many instances by way of explanation or apology, but we may dismiss this reason as being quite an exceptional one.

The second characteristic is largely due to the parsimonious spirit in which the work is undertaken and carried out. The number of lights is reduced to a minimum and proves altogether inadequate for the purpose; a low price tender is accepted, and the contractor necessarily proceeds along the lines of a most rigid economy in the use of material as well as in other ways, irrespective of all considerations of taste and effect.

The third characteristic is very likely attributable to the circumstance to which we referred at the commencement of this article, viz., want of confidence. Public confidence is a thing of slow growth, and in this respect the history of electric lighting is no exception to the general rule; on the contrary, its *début* and early history was calculated rather to awaken distrust than confidence.

The phenomenal progress of electric lighting in more recent years, since its pioneering failures, has not been accompanied by an equal growth of the public confidence, and at this we, who are behind the scenes, need scarcely affect to be surprised.

It will be observed that our remarks have reference to public buildings only; and here we may incidentally observe that such defects and disfigurements are very seldom seen in private installations. To sum up. If we were called upon to place our finger on the one predominating cause of the faults we so commonly see and deplore, we should unhesitatingly point to the want of confidence. In confirmation of this view, we need only call attention to the restrictive clauses which generally form the principal portion of the specifications for public lighting contracts. This want of confidence, however, is rapidly abating. It lingers still, and justifiably so, perhaps, in relation to the adoption of large public schemes, but for private lighting purposes, competition in business and other influences have aided the adoption of the electric light, rather than retarded it.

The foregoing remarks may be considered to account, in a general way, for the very unsatisfactory manner in which buildings devoted to the use of the public are electrically lighted; but there are other circumstances which operate in the same direction, and help to explain, if they do not altogether justify, the unsightliness of which we are discoursing.

It is very likely that the temporary appearance which these installations present is in fact *only* an appearance, and that they are really of a permanent nature. What further is there then, we may ask, which interferes with perfect freedom in the use of the electric light, and in the carrying out of installations? We have not very far to look for an answer. The only remaining party who has a voice in the matter is the fire insurance company. Each of these companies adopts certain rules, which, for all practical purposes, are an adaptation or a modification of the well-known Phœnix Fire Office rules. No exception can, of course, be taken to these regulations, which, notwithstanding they were drawn up in the days of pioneer electric lighting, are quite as necessary now to provide against the dangers arising from cheap and inferior work. These rules are as excellent as they are necessary, and are enforced most stringently in every case by the fire insurance companies; but the inspector appointed to watch their interests is, unfortunately, usually totally devoid of electrical knowledge. He is, therefore, quite unqualified to decide, on his own responsibility, how far any method, which is not strictly in accordance with his instructions, is unexceptionable or fairly permissible.

It often happens that a deviation from, or, rather, a modification of the rules, would be far more convenient, without in any way increasing the risk; but of this the fire insurance inspector would be no competent judge.

It is just on this point that the difference between private and public electrical work comes in. Private work is nearly always executed according to the tastes of one individual, and the insurance inspector may be easily persuaded that the precautions taken are to his satisfaction. Moreover, the risk in these cases is borne by one company, and for the sake of business, in consequence of keen competition with other companies, many departures from the code are allowed. But in public buildings insured in a number of offices, and where the risk is often enormously great, the execution of the work is a matter which is left almost entirely to the contractor, as it would not be wise for one individual unacquainted technically with these things to compromise the safety of the whole building.

The argument intended here is, that there is no discretion shown on the part of fire insurance companies between first-rate and third-rate electrical work, but that they enforce the strict observance of their rules irrespective of the quality of the work to be carried out. That this is in many cases quite unnecessary is well known, and many public electrical contracts might otherwise be carried out in a more artistic manner were they not circumscribed by the same rules as are applied to work of an inferior and questionable nature. On the other hand, it is not an uncommon thing for public authorities to reject tenders which suggest any serious alteration to the building necessary to make the installation a practical and artistic success.

We have now the facts before us, and it is not a difficult matter for an adept in these things to discern where the line should be drawn, but it is essentially a question which will only be satisfactorily solved by the demands of the public, and by the gradual wearing away of popular prejudices.

The revision of existing rules against fire risks, and the less-constrained adoption of the electric light as other factors in installation work become recognised, are necessities which will as speedily become facts, as the electric light in itself has become popular.

The Waterloo to Mansion House Electric Railway.—A long postponement of the consideration of the suspended Bill of last year for powers to construct an underground electric railway from Waterloo Station to Mansion House Street has resulted in the withdrawal of the opposition of the South Eastern Railway Company, who were opposing not only on the ground of competition with their railway from Waterloo to Cannon Street, but also on the ground of alleged breach of faith on the part of the South Western Railway in indirectly promoting this railway.

SHUNT MOTORS.*

BY W. D. WEAVER.

MANY makers of dynamos and motors rate their machines at the same number of kilowatts, whether used as generators or motors, but it does not follow, of course, that the power at the pulley is the same in both cases with the same voltage at the binding posts. The amount of this difference for a given machine as well as several other practical problems in regard to shunt motors are given below, with reference to the data of an actual machine, as follows :

Voltage at dynamo, 110 = V.
Revolutions per minute, 800 = N.
Full load, ampères in exterior circuit, 60 = C_e.
Full load, ampères in armature = C_a.
Ampères in shunt, 27·5 = C.
Resistance of armature, ohms, ·1 = R.
„ shunt, ohms 40· = R.

Considering the machine first as a dynamo, the power delivered to the exterior or useful circuit is C_e V = 60 × 110 = 6,600 watts. The energy supplied will be in excess of this by the watts required for the shunt, or C_s V = 2·75 × 110 = 302 ; the watts required to overcome the armature resistance, or $(C_e + C_s)^2 R_a = C_a^2 R_a = (60 + 2·75)^2 \times ·1$ = 393 ; and the watts required to overcome the air and load friction, eddy currents and hysteresis, which we will assume to be 630 in the present case. The total power required to be delivered to the pulley will be the sum of the above, or 6,600 + 302 + 393 + 630 = 7,925 watts, which will give a net or commercial efficiency of $\frac{6,600}{7,925}$ or 83·3 per cent., and an electrical efficiency of $\frac{6,600}{7,925 - 630} = 90·4$. The mechanical horse-power required at the pulley will be $\frac{7,925}{746} = 10·6$ and the electrical horse-power delivered to the useful circuit $= \frac{6,600}{746} = 8·8$. The useful torque at one foot from the axis of the shaft $= \frac{\text{foot pounds}}{2\pi \times \text{rev.}} = \frac{10·6 \times 550}{2\pi \times \frac{800}{60}} = 69·7$ pounds. The entire E.M.F. generated is the sum of that of the exterior circuit, and that lost in the armature, or E = V + $C_a R_a$ = 110 + (60 + 2·75) × ·1 = 116·275 volts.

In considering the same machine as a motor fed from a 110-volt circuit, the armature reaction will be neglected and the losses through load and air resistance, hysteresis and eddy currents, will be assumed to vary directly as the revolutions, in order to avoid complication. The manner in which the armature reaction would affect the result will be indicated later, and the magnitude will be less the greater the relative strength of the shunt field. The error in the assumption in regard to hysteresis, friction and eddy currents, is probably too small to practically affect the results.

Assuming that the motor is so loaded that 62·75 ampères pass through the armature (its full load as a dynamo), the voltage lost in the armature through resistance is $C_a R_a$ = 62·75 × ·1 = 6·273 volts, and in order that no more nor less than this current shall pass through, the armature acting as that of a dynamo will have to generate 110 − 6·275 = 103·725 volts of back E.M.F. The field being constant through the shunt always taking the same current, the revolutions to generate this back voltage are $\frac{103·725}{116·275} \times 800 = 713$, which is the speed of the motor under the given conditions. The energy supplied is $(C_a + C_s)$ V = (62·75 + 2·75) 110 = 7,205 watts. Of this there are used in the shunt, C_s V watts = 2·75 × 110 = 302 ; in the armature, $C^2 R_a$ watts = $62·75^2 \times ·1$ = 393 ; and in the other losses $\frac{713}{800} \times 630 = 562$ watts, which leaves 7,205−(302 + 393 + 562) = 5,946 watts for mechanical work. The net or commercial efficiency of the motor is $\frac{5,946}{7,205} = 82·5$ per cent., and the electrical efficiency $= \frac{7,205 - (302 + 393)}{7,205} = 90·4$ per cent. The net horse-power is $\frac{5,946}{746} = 7·97$ and the useful torque = 7·97 × 550 divided by $\frac{713}{60} \times 2\pi = 58·7$ pounds.

From the above it will be seen that while the machine as a dynamo took 10·6 mechanical horse-power with the full load armature current of 62·75 ampères, as a motor with the same current in the armature, the pulley horse-power is only 7·97, a reduction of 25 per cent. It is also interesting to note that while in this case the electrical efficiency as a motor remains the same, the net efficiency is decreased.

To find the current required in the armature of the motor for any load at the pulley, let M = the given load and h the losses from friction, hysteresis and eddy currents ; the value of h will be considered constant to avoid complication, which will introduce little error on account of the revolutions of a shunt motor varying little with varying loads, and the load friction varying inversely with the other losses. The entire energy supplied to the dynamo is V (C + C_s) which must equal the expenditures, M + h + C^2 R + V C_s, from which equalities we find $C = \frac{V - \sqrt{V^2 - 4R(M + h)}}{2R}$.

For a load of 75 per cent. of the full load, the value of M is ·75 × 5,946 = 4,459 watts ; and substituting this and h = 562, V = 110 and R_a = ·1 for the above formula, we find C_a = 45·5. Proceeding as before, this gives 5·98 commercial horse-power and 724 revolutions, with a commercial efficiency of 79·6 per cent., and a useful torque of 43·5 pounds. The various values for loads of 50 per cent., 25 per cent. and 10 per cent. have been similarly calculated, and are given in the accompanying tables.

It will be seen that for a given load the torque is fixed if the field remains constant. With the motor under consideration, the lowest number of revolutions is 713, as any less speed would permit too large a current to pass through the armature, and this corresponds to a torque of 58·7 pounds. These quantities are, then, the lowest limit of revolutions. and the highest of torque if the field is kept constant.

It will be interesting to examine into the effect of changing the strength of field, and we will take the case of the present motor at full load. Suppose the field circuit has a rheostat which will permit a greater or less current to enter the shunt, and, further, suppose the torque of the load to remain practically constant, which it will in many actual cases. As the torque is proportional only to the strength of the field and current in the armature, it follows that if the field is strengthened the current in the armature will be reduced, and *vice versâ*.

If the field is strengthened 10 per cent. in the present case, the armature current will therefore be reduced in the same ratio or to 62·275 − 6·227 = 56·04 ampères, which will require $C_a \times R_a$ = 56·04 × ·1 = 5·604 volts to force it through the armature, and a back E.M.F. of 110 − 5·604 = 104·29 volts to keep the current from exceeding the required strength. If this increase of the strength of the field were made with the machine as a dynamo at 800 revolutions, the total E.M.F. would be 116·270 + 10 per cent., or 127·9 volts, and consequently, the motor acting as a dynamo in generating a back E.M.F. of 104·29 has a speed of $\frac{104·29}{127·9} \times 800 = 652·6$ revolutions. As the torque is the same as before (58·7 pounds) the commercial horse-power, varying only as the revolutions $= \frac{652}{713} \times 7·97 = 7·15$.

The increase of current required in the shunt to bring the field up 10 per cent. in strength will depend on the state of the field cores in regard to saturation, and in the present case, we will assume that the current will have to be increased 60 per cent., or to 2·75 + 1·65 = 4·4 ampères. The commercial efficiency will then be found 79·5 by the methods used above, and the electrical efficiency, 88 per cent.

If the field were weakened 10 per cent. the armature

* *The Electrical World.*

current would be increased in the same proportion, or to 68·5 ampères, requiring a back E.M.F. of 110 − 6·85 = 103·15 volts. Acting as a dynamo the machine at 800 revolutions would generate 116·275 − 11·6275 = 104·6475 volts, and the motor therefore in acting as a dynamo in generating 103·15 volts would have a speed of $\frac{103{\cdot}15}{104{\cdot}6475} \times 800 = 788$ revolutions. Proceeding as before, this gives a commercial horse-power of 8·7 with a commercial efficiency of 84·3 per cent., and an electrical efficiency of 91·6 per cent., the current in the shunt being reduced 40 per cent. to decrease the field 10 per cent.

While there is thus a gain in both power and efficiency by weakening the field, the motor with a weak field would be undesirable on account of the sparking caused by the greater shifting of the resultant field with variations of current in the armature, and the greater variation of revolutions for a given variation of load.

Another interesting point remains, that of maximum efficiency. As the energy commercially utilised is $V C_a - h - C_a^2 R_a$ and the entire energy supplied is $V C_a + s$, where s = the shunt watts, the commercial efficiency is $\frac{V C_a - h - C_a^2 R_a}{V C_a + s}$ and, similarly, the electrical efficiency is $\frac{V C_a - C_a^2 R_a}{V C_a + s}$. These are maxima when C_a is

$$\sqrt{\frac{s+h}{R} + \left(\frac{s}{V}\right)^2} - \frac{s}{V} \text{ and } \sqrt{\frac{s}{R} + \left(\frac{s}{V}\right)^2} - \frac{s}{V}$$

respectively. Substituting these gives values for C_a of 90·25 and 52·95 ampères respectively, so that the maximum of commercial efficiency entails a greater current and load than the armature can carry—quite a different result from the illustration in text books, where an infinitesimal current and load result from neglecting the losses. The efficiencies and other quantities resulting from these currents are given in the table.

	C_s.	C_a.	Rev.	Com. H.P.	Torque.	Com. Eff.	Elec. eff.
Dynamo, full load ...	2·75	62·75	800	10·6	69·7	83·3	90·4
Motor, " " ...	"	62·75	713	7·97	58·7	82·5	90·4
" ¾ " ...	"	48	724	5·98	43·5	79·6	89·6
" ½ " ...	"	33·2	731	3·98	28·6	74·9	89·1
" ¼ " ...	"	19	742	1·99	14·1	61·8	85·2
" 1/10 " ...	"	10·6	748	·796	5·58	39·9	77·8
Full load torque, field increased 10 per cent.	4·4	56·04	652	7·15	58·7	79·5	88·
Full load torque, field decreased 10 per cent.	1·65	68·5	788	8·7	58·7	84·3	91·6
Maximum commercial efficiency	2·75	90·25	694	11·4	86·6	83·6	89
Maximum electrical efficiency	2·75	52·95	720	6·68	48·7	81·3	90·5

The effect of armature re-action is to weaken the field by the amount of the resultant back field of the armature, so that in all of the above cases all of the quantities would be increased, and in a proportion greatest with the largest current.

The table shows what little value electrical efficiency has in a commercial sense. A machine might have a high electrical efficiency, yet a very low commercial efficiency if the losses from eddy currents and hysteresis were high.

THE ELECTRIC LIGHTING OF DRESDEN.

[FROM OUR OWN CORRESPONDENT.]

THE plans which have been offered for the erection of electric works in Dresden resolve themselves into three groups.

The first group comprises plans for the network of distribution of continuous current for the district and for the supply of electric energy from a central station situate at Reick. To this group belong the projects I., II., IV. and V. of Schuckert and Co., the project of Siemens & Halske, I., and further, the project III. of Schuckert & Co. (conduction with a continuous current and accumulator, sub-stations), which will not come further into consideration as it depends on a supposition which cannot be realised, that the generating station should be erected at the former railway station. This project had not been really recommended by Schuckert & Co., but only put in for comparison.

The second group includes plans with generator stations (gas engines) situate within the city, batteries of accumulators, and a net for the distribution of continuous current. To this group belong the projects I. of O. L. Kummer & Co., and IV. of Siemens & Halske; a project by Schuckert & Co., sent in too late, would also belong here if it could be considered.

The third group includes plans with a net for distributing alternating current and a generating station at Reick. It includes the projects of the General Electric Company, of Helios, of O. von Miller, the project II. of O. L. Kummer and Co., and the projects II. and III. of Siemens & Halske.

Supposing equal certainty of working, we should in any case prefer the continuous current to the alternating current, if the former could be constructed without greater expense than the latter, or with an expense only slightly greater. It is therefore before all things necessary to compare the plans with each other from the point of cost.

For such a comparison, besides the estimated cost of land and buildings, we have to consider the current outgoings for power, for maintenance and management, the extent of the depreciation fund and the interest on the capital invested, and, lastly, the returns expected for the current supplied.

To ascertain the outlay for land and buildings with any approach to accuracy would involve the co-operation of the municipal authorities, and especially of the Board of Works, as the various plans make different demands regarding the extent of land and buildings they would require, to be worked out separately and in detail.

The expenses of working can be estimated with some degree of probability if we make definite assumptions as to the probable demand for current. Such assumptions, however, cannot be other than uncertain. The cost of the production of current in a strict sense forms such a small fraction of the total expense, that the extent of the demand for current has only a moderate influence on total working cost.

The cost of maintenance can be estimated for those plans which do not require large batteries of accumulators. For such batteries, the Hagen Accumulator Works, which would exclusively come into consideration, furnishes a guarantee that the capability after a lapse of ten years is only a little reduced from its original state. But hitherto data are wanting to show how the maintenance of such a battery will come after expiry of the ten years of the guarantee.

As regards the cost of the sinking fund and interest, the most discrepant assumptions are made from various sides. The percentages on which such a calculation can be founded must be prescribed on behalf of the city. They are of great importance, since the sinking fund and the interest may easily make up half the total outlay.

Assumptions as to the returns to be expected are very uncertain. The income depends absolutely on the consumption of current, and it is absolutely impossible to foretell how it will turn out.

Accordingly a determination of the total cost of the current, even if made with all conceivable care, would afford a result of such doubtful value, that it would not bear any proportion commensurate with the tedious and extensive work of its elaboration.

Hence it appears advisable in comparing the different plans to take in the first place as a foundation, the installation cost of the works, the rather as it determines the sinking fund and the interest.

For this purpose the various plans in question have been collated in the form of a table, assuming round sums for buildings, meters, connection with houses, office arrangements, and for plots of land within the city, as far as they come in question. As the estimates of cost do not exclusively refer to identical or corresponding things, and as various items (packing, freight, mounting, laying cables, engineer's charges, &c.) are calculated in different manners, in order to make the estimates comparable, some things must be added or omitted, and the general expense must be distributed as well as possible among the different items. This equalisation

and distribution is, of course, to some extent arbitrary, and has no very great influence upon the total result.

The table shows that the cost of installation for all the plans of group I. (continuous currents distributed from a station at Reick) would cost, in round numbers, half a million marks more than the other two groups. The great difference is determined by the complexity of the systems. These plans (group I.) have *both* extensive subordinate stations within the city (resembling the gas-engine stations of group II.), and *also* a machine station at Reick, like the plans of group III.

Even if a more exact manipulation of the plans might yield figures diverging from those of the tables, it can by no means be assumed that the great difference of the installation costs of group I., and those of the other groups, might disappear. We may rather, on the basis of this preliminary examination, advise the authorities to decline the execution of the electric works according to any of the plans of group I., on account of the excessive cost of installation.

It must not pass unnoticed that extensive electric works, in the manner of group I., have not yet been carried out, and that, consequently, practical experience as to the suitability of such works is not accessible. Concerning the relatively small electric works at Kassel, very contradictory decisions have been made public. The undersigned visited these works on April 27th, 1892, and have obtained the best possible intelligence, both by inspecting the installation in action, and by collecting opinions. They arrived at the conclusion that the advantages of the continuous current would not compensate the disadvantages of so complicated a system, not even if various improvements were introduced on constructing larger works on such a system.

In the groups II. and III. the expenses for the first installation are about equally high, *i.e.*, on the average 1½ million marks. The cheapest and the dearest plans of group III. are, respectively, rather cheaper than the cheaper and dearer than the dearer of the two plans of group II. Here it must be mentioned that gross sums have been put down for the buildings to be erected for both groups, and for the land to be purchased under group III. at Reick. The figures of the table do not afford a comparison of the two groups in general, but merely in respect to the actual conditions of the localities.

The comparison of the two groups as to the cost of subsequent extensions, and of working expenses, gives a different result from the comparison of the first installation.

An electric works of the kind of group II., that is to say, with separate generating stations in the interior of the town, and power obtained from gas engines, could be enlarged only by the erection of new stations, necessitating the acquisition of new plots of land, whilst works of the type of group III. would require merely an enlargement of the machinery station, for which the land of the gas works would afford sufficient scope. The enlargement of the conductive net would be about equally expensive in both cases. We may assume that in enlarging works of the kind of group II. the expense will grow in proportion to the size of the works, whilst at works of the kind of group III., the enlargements will be cheaper than the first installation.

The working cost in II. is much higher than in III., since the gas engines required in the former work less advantageously than the steam boilers used in the latter.

(*To be continued.*)

THE APPLICATIONS OF OZONE.

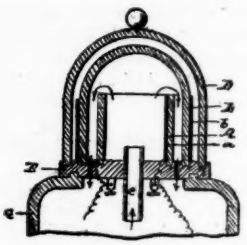
[FROM A CORRESPONDENT.]

(*Continued from page* 309.)

Dr. de Vars, 1889.

Dr. de Vars had several medical installations or ozonic sanatoriums in Paris, and in the country, where he cured his patients by means of ozone in inhaling rooms.

This ozoniser is exactly the reproduction of an apparatus described long before by Berthelot, fig. 10 *bis*, for the electrification of gases (*Annales de Chimie et de Physique*, 5th series, T. xii., p. 457).



A, Glass cylinder coated inside with tinfoil, *a*; B, Glass bell cover, coated outside with tinfoil, *b*; A and B fit in circular grooves in the ebonite stand, E, about 5 mm. apart; *a* and *b* are connected to the terminals of an induction coil D, Glass bell covering and insulating the whole arrangement.

Fig. 10.—De Vars Ozone Bell.

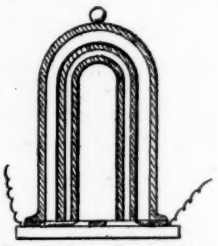


Fig. 10 *bis*.—Berthelot.

Seguy, 1890.

A very clever glass-blower in Paris, M. Séguy, constructs small apparatus which, like almost all the other generators are tubular.

Fig. 11 shows a combination of the Houzeau and Babo tubes in the shape of a tube bent so as to present a long ozoniser in a small compass. But there are six connections to make instead of two; the instrument lacks simplicity, and cannot be as good as an ordinary Houzeau ozoniser.

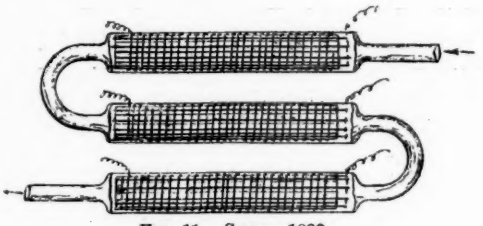


Fig. 11.—Seguy, 1890.

The ozone is generated when the oxygen of the air is acted upon by the silent discharge while passing through an annular space of minute dimensions between two concentric

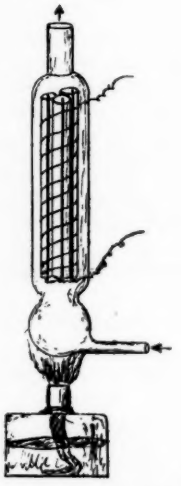


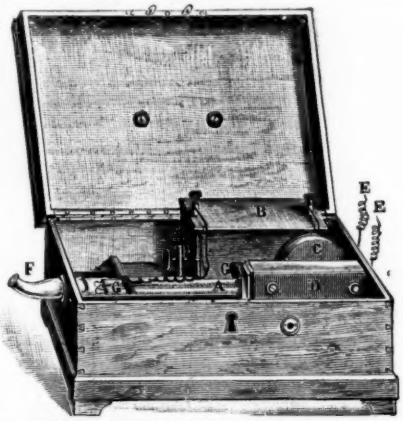
Fig. 12.—Seguy Inhaler

tubes. Therefore, the air must be forced by means of a blower; in order to effect this automatically, M. Séguy has availed himself of the principle of the ascension of heated

air, and fig. 12 shows an ozoniser, the outlet of which can be used as an inhaler. These small ozone generators are greatly used in Paris for medical purposes.

GUENET, 1891.

This instrument, fig. 12, is a multitubular tube, as the maker, M. Guénet calls it, *i.e.*, a tube containing several tubes. According to his printed statement, this ozoniser which is worked by a battery giving 4 volts and 4 ampères, can



A, Ozonising multitubular tube, 23 mm. diameter containing 3 tubes, 8 mm. diameter, each containing an aluminium rod, 3 mm. diameter and 150 mm. long, and surrounded by a thin aluminium wire 1·6 m. long; B, Coil; C, Ventilator; D, Clockwork mechanism to operate C; E E, Connecting wires; F, Outlet.

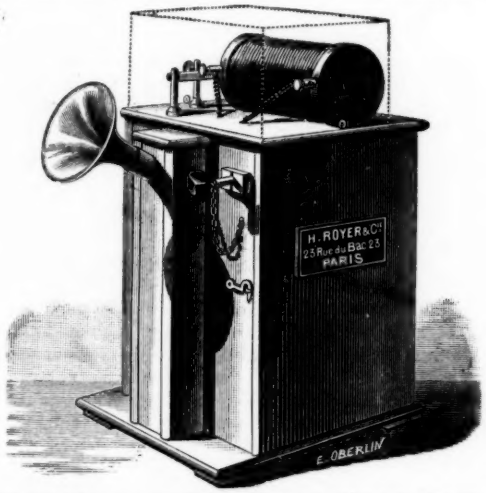
FIG. 13.—GUENET.

ozonise 50,000 litres of air in 15 minutes! It would be curious to know how many cyphers too much were inserted in this obvious misprint.

DRS. LABBÉ AND F. OUDIN.

The current belief that ozone is dangerous is due to the experimental conditions adopted many years ago, when physicists prepared it by means of chemicals, thus forming an impure and almost toxic compound, or when they submitted animals in closed vessels to the action of ozonised oxygen. Drs. Labbé and Oudin have substantially and effectively demonstrated that ozone, when not in excess, does not present any danger to the person who breathes it.

Their apparatus is essentially medical. It differs from the others, which have two metallic armatures. The atmospheric air is ozonised by the electric discharge when passing through



A box containing an accumulator, on the top of which is the induction coil under a glass lid, in connection with the two poles of ozonising tube in the shape of a trumpet inhaler.

FIG. 14.—DRS. LABBE AND OUDIN'S MEDICAL OZONISER.

the annular space which separates an *inch glass tube, containing rarefied air*, which acts as a good conductor, from the *internal metallic armature* of an outer glass tube. The distance between these two tubes is 2 to 3 millimetres, and the slightest rise in the temperature is sufficient to produce a draught of air which forces out the ozone.

In a paper read at the *Académie des Sciences*, Labbé and Oudin developed their theory on the molecular displacement and the transport by the current of the metal used as an electrode. They employed 10 tubes, 80 centimetres long, similar to the one just now described, and which were connected in quantity with a condenser, to a transformer, worked by a Gramme alternator. They said that at 7,000 and 8,000 volts, the aluminium armatures of these tubes were attacked and the atmosphere of the laboratory was filled with bluish mist, which could only be aluminium or aluminium oxide.

There is nothing but what is natural in the volatilisation of the thin aluminium foil armatures of these 10 small tubes, working at the rate of 8,000 volts. The contrary would be very surprising.

The Labbé apparatus, constructed by Messrs. Royer in Paris, is represented in the engraving (fig. 13).

The Labbé ozonisers are applied in most hospitals in Paris, and Drs. Labbé and Oudin claim that ozone is a powerful therapeutic and prophylactic agent in all contagious diseases, small pox, measles, diphtheria, scarlatina, whooping cough, &c.

DR. GIRERD.

As a sequel to the theory of Drs. Labbé and Oudin on the volatilisation of metals under the influence of the effluvia, we have now Dr. Girerd's ozoniser, in the inter-annular space of which are packed pieces of very thin metallic foil such as aluminium, gold, iron, and tin which present a great surface, and can, according to Dr. Girerd, be easily volatilised by the

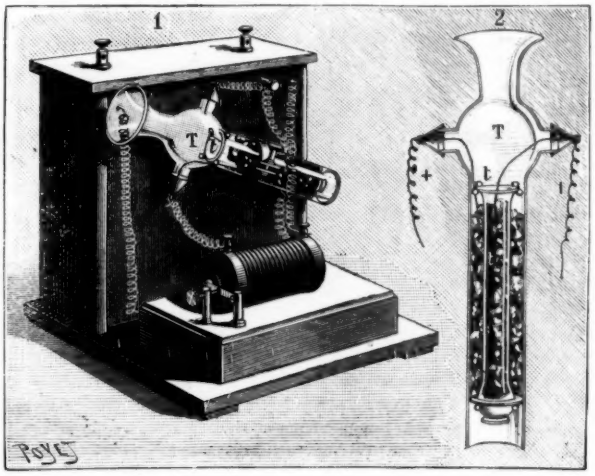


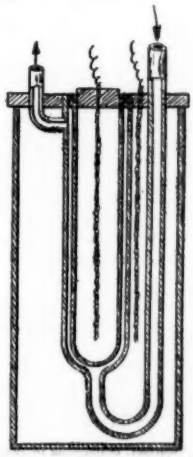
Fig. 1 shows an apparatus 20 centimetre curve; a glass tube, T; a 6 mm. spark coil; a box containing the battery.
In fig. 2 are seen the inner tube, *t*, and the outer tube, T, both full of finely beaten aluminum foil; + and − show the two poles.

FIG. 15.—DR. GIBERD.

electric current. This application of ozone is really a cure by metallic vapour, and it is not, therefore, for me to discuss its properties.

SIEMENS, 1891.

This apparatus, in its shape, is very much like the first one devised by W. Siemens in 1857.

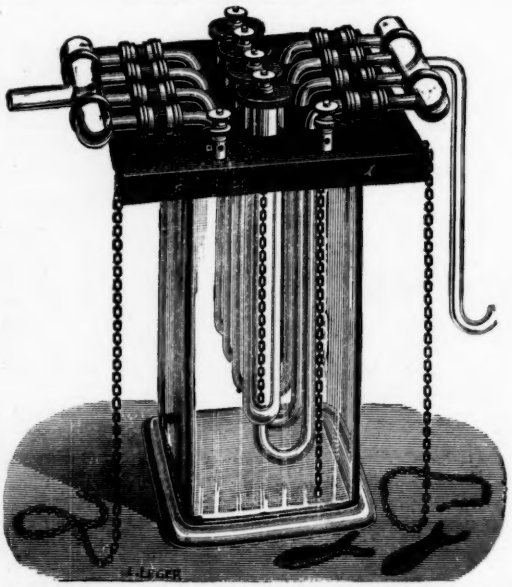


The outside and inside tubes are filled with acidulated water, in each of which a platinum chain dips and works as an electrode

FIG. 16.—SIEMENS AND HALSKE, 1891.

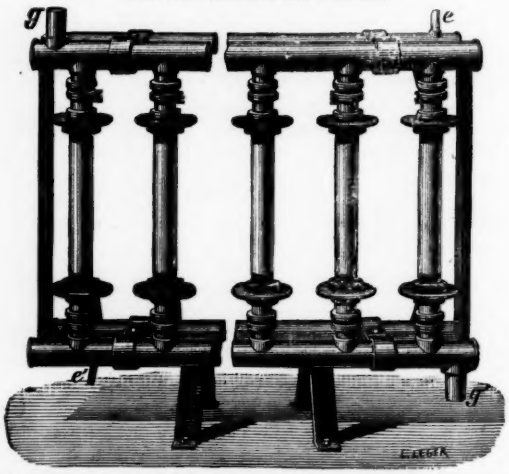
a, o, Metal tube surrounded by a glass cylinder coated with aluminium; w, Tube for circulation of cold water. The dotted lines represent a series of holes through which the air or oxygen enters at o, goes into the circular space between the metal and the glass tube, and escapes after having been ozonised.

Fig. 17.—Siemens and Halske.



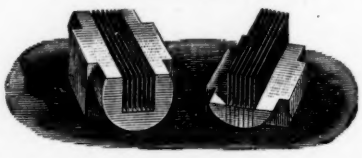
Apparatus showing four tubes, as above, arranged together, where the air or oxygen enters through one of the pipes, is electrified while flowing through the tubes, and is driven off as ozonised air or ozone.

Fig. 18.—Siemens and Halske.



10 ozonisers disposed upon two double parallel tubes, the one for oxygen, and the other for the water which keeps the apparatus cool.

Fig. 19.—Siemens and Halske.



Other form of Siemens ozoniser, consisting of two halves of alabaster tubes in one of which are fitted the metallic electrodes, and in the other are the dielectric sheets which separate the electrodes.

Fig. 20.—Siemens and Halske.

The *Electrical World* of November 5th, 1892, describes an installation of ozonising tubes, containing acidulated water which, at the Wellesley College in Boston, serves for purifying the air in the drawing room, chapel, library, &c. The Ozone

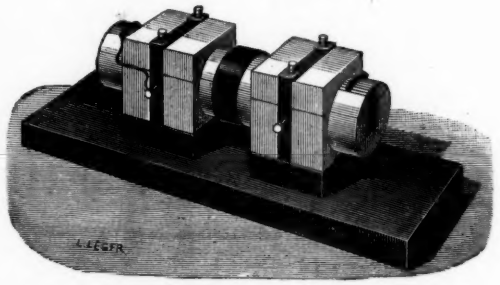


Fig 21.—Same Apparatus as Fig. 20 when Closed.

Manufacturing Company, of New York, who pretend to be the only company producing ozone commercially, have exhibited their apparatus at the meeting of the Electro-Therapeutic Association at the Academy of Medicine. This apparatus is constructed for purifying the air in large buildings. A small motor was operated by a branch of the 110 volts incandescent current of the building. The motor worked a blower which forced the air through drying tubes. The dried air passed through seven ozone tubes acted by the high tension transformer bringing the 110-volt current to 14,000 volts.

(To be continued.)

ELECTRIC TRAMWAYS IN VIENNA.

[from our own correspondent.]

The Anglo-Austrian Bank, after a thorough investigation carried on in concert with the firm of Siemens & Halske, and with the Universal Austrian Electric Company (Allgemeine Oesterierchische Electricitäts Gesellschaft), has come forward with the project of forming a company, which, in the manner of the electric city line at Budapest, is to lay down tramlines in the municipal territory worked by electric power. At present a communication has this day been handed in to the City Council which contains a detailed project for a line encircling the inner city, as also for a branch line through the inner city. The ring line beginning at the Praterstar is to be carried over the Franzbrücke, through the Weisogerberstrasse to the Radetzkybrücke, from here through the Zdlamtstrasse and on to the Elisabethbrücke, then, after crossing the Wien, it will be continued into the Museum and Landesgerichtsstrasse and enter upon the intersection of the Schwartspanier and Wätiringstrasse, to be ultimately continued to the Danube Canal.

The branch line will strike off from a point in the Landesgerichtstrasse passing through the Grillpazzenstrasse across the Franzend Circus into the Helferstorferstrasse, and from there through the Exchange Square and the Candorden Square to the Ferdinands Bridge. In case the concession is granted the construction of the line will be undertaken by Siemens & Halske after the design of the Budapest city line. This line is to be entirely above ground and obtain its current by a cable in a channel placed below one of the rails. The current required will be supplied by the Allgemeine Oesterieirchische Electrictäts Gesellschaft, which has just completed a second large central station in the Leopoldstadt. The main line from the Praterstern to the Wähiengerstrasse coincides in large part with the so-called inner ring line which forms an important member of the projected city line. Among the city lines which the law takes into consideration for the first period of construction, there are three lines which the Traffic Commission is about to construct, and three lines which are to be left to private enterprise, *i.e.*, the Danube Canal, the Wien Gates, and the inner ring line. So far there has been only one applicant for the three inner lines of the town tramway, *i.e.*, the Krausche (?) steam line, com-

pany which has been for some time negotiating with the Government about steam power on the city line.

The Anglo-Bank has now come forward as a second applicant for the three lines. Thus the Government is not only presented with a choice between the two applicants, but has to solve the fundamental question whether electric lines are to be introduced in Vienna or not. At the same time there again arises the question whether a railway should be conducted through the inner city.

It is to be hoped that all these questions may reach an early solution, for it is high time to pass from the condition of negotiation to that of realisation.

As an appendix to this notice, I mention that in Budapest the tram company (horse power) has coalesced with the electrical town undertaking, and if this agreement is really carried out, Budapest will have a net of electric lines on an imposing scale. The first point is the enlargement of the existing net and its partial combination with the tramways, so that some parts of the tram lines may be provisionally used by the electric vehicles simultaneously with the horse-cars. Both undertakings will also open new lines in the part of the town on the right bank of the river (Ofen), and the intercourse between the two banks will be provisionally effected by means of omnibuses pending the construction of the projected Danube bridge for the electric line.

ELECTRICAL TRANSMISSION OF POWER FOR MILLS.

MR. C. J. H. WOODBURY discusses this subject in a paper read before the New England Cotton Manufacturers' Association. Electricians may congratulate themselves when they observe how the use of electricity has become so fashionable that engineers appear to be afraid of being considered backward unless they advocate electricity right and left, with but little regard to its suitability. Mr. Woodbury is too practical a man to be led far away in this direction, but still exhibits something of the regard for electricity, but he plainly states that it is, after all, but a mode of power transmission. He refers to the use of electric motors in working elevators. We do not see much in this when the locality of application is a cotton mill or other similar building, with power immediately available from shafting, but there are hundreds of warehouses in Manchester and other cities, where, while there is required no power for packing, there is quite a lot of hoisting of goods to upper floors which is laboriously performed by a manual rope hoist. For such places as these the electric motor is most suitable, and ought to displace the cruelly hard work involved in carrying up many stairs heavy packs of goods, such as are carried by the porters attached to the vans of the bleachers and finishers, which may be seen any day in Manchester. Our author is not hopeful of the substitution of electricity for belts or ropes in conveying power to individual machines so long as the cost of the apparatus, wires, &c., is as high as $100 per horse-power.

Motors deriving current from dynamos worked by a badly governed water-wheel, are not, he states, sufficiently steady to drive Fourdrinier paper machines. We are glad to see Mr. Woodbury appreciates the difference between short distance and long distance transmission, for it is in long distance work that electricity will find its chief field of action. The Frankfort Exhibition of last year, with its 109 miles of electrical transmission, Californian examples, where as many as 27 miles are covered in some cases, the ten miles of transmission to Hartford, Conn., from a 300 horse water power at Tariffvale, are cited, and, for its many ingenious features, the transmission of power to the mills of the Nonotuck Silk Company at Leeds and Haydenville, Mass. In this instance power is taken from a fall in a river gorge about $\frac{1}{3}$rd of a mile from one mill and $1\frac{3}{4}$ miles from the other, the electric motors being merely auxiliary to a water power at the mills, where a fall of $12\frac{1}{2}$ feet gives 100 H.P. to two wheels run at full gate without regulator, the motor serving as regulator and furnishing the balance of power required. When the power required is in excess of that given by both wheels and motor, a steam engine is belted to the shaft, and this is then the regulator of the speed, the full power of the water-wheels and motor being absorbed. In such a case the engine leads and assists the other motors to maintain speed.

The fall at the gorge, which is quite unsuitable as a mill site, is 30 feet, and is utilised by two wheels, one of 90 H.P. driving a 950 lamp dynamo, the other of 130 H.P. driving a Thomson-Houston dynamo of 85 H.P. and one of 30 H.P. At the nearer mill are two motors of 20 H.P., one of 45 H.P., and one of 10 H.P., and somewhat similar arrangements are in use at the further mill.

Though to our mind a cotton mill of modern design does not seem to afford a rational field for electrical transmission, there are, no doubt, many large works of gradual growth and therefore of intricate plan and build wherein ordinary means of transmission are inordinately costly. To such as these electricity is more especially worth application, and in regard to large works the term "long distance transmission" may very rationally be applied to comparatively short distances.

The necessity of crossing a public road may, for example, constitute a case to which we might technically apply the term, and equally, the possibility of leading water by a sheet-iron pipe or flume cheaply to a mill, in order to there work a turbine, might, on the other hand, warrant us in rejecting transmission by electricity, especially if, by means of the flume, a needed supply of water was made available for other purposes. In the United Kingdom, Ireland seems to afford a field for electrical enterprise by reason of her limited fuel resources. The Shannon, which is said to discharge a volume of water equal to the joint flow of the Thames, Severn, Trent, and Mersey, has doubtless other water-powers in its course of 200 miles than the remarkable drop at Killaloe, whilst the turbine, fed by fluming of the style used in New Zealand and California, gets over the difficulty of heavy works such as are exemplified in the great wheel at Laxey. There are so many places where electricity is practically the only means of utilising or transmitting a power, that its indiscriminate application is to be deprecated.

If the present suicidal policy exhibited by the railway companies is to be continued, and much traffic thrown upon the common roads of this country, there is a prospect of calling in the aid of electricity as a means of overcoming some of the steeper gradients and enabling teams to dispense with an extra horse. Necessarily the employment of electricity in power transmission will always find its greatest field upon a continent with rivers of large volume rather than in our own country where our rivers have but moderate flow and falls of small height.

HEAT MOVEMENT IN STEAM ENGINE CYLINDERS.

SINCE Hirn first put into form the modern idea of the steam engine and showed how important was the action of the inner surface of the cylinder upon the working steam, there have been many workers along the same line, and now we have Prof. Kirsch of Chemnitz, endeavouring to show the movements of heat in the cylinder walls. There will be, he says, a certain thickness of the walls in which the temperature will fluctuate, the limiting depth to which fluctuation extends being deeper with metal of better conductivity and nearer to the surface according as the revolutions of the engine are greater. Assuming that at the limiting depth the fluctuation is only a thousandth part of that in the layer next the steam, then this depth will be 26 millimetres at 25 revolutions and 13 millimetres at 100 revolutions. Under ordinary conditions, therefore, there is no fluctuation upon the outer surface of the cylinder, nor has the thickness any effect on the time of fluctuation. He endeavours to deal with the subject and reduce the enquiry to the simpler question, What is the temperature of the innermost surface at any given point? This cannot be answered, for we do not know the relation between the temperature of the cylinder wall surface at any moment, and of the steam in contact with it.

There is not anything advanced of special originality. It is we think, generally conceded that if the steam be hotter than the cylinder wall, it will condense upon this and quickly heat up the surface, and on the contrary if the cylinder be hotter than the steam and water in contact with it, it will as

rapidly part with its surplus heat until it has dried the steam when there will be a sudden diminution of the heat flow from the metal to the steam. The professor concludes, with every degree of probability, therefore, that while the steam cannot be hotter than the cylinder, the cylinder may be hotter than the steam for some time. Except where steam is superheated its temperature can be ascertained by the indicator. Were the wall always wet, therefore, its temperature could always be found by the indicator, but when the wall becomes dry this is impossible, for the dry wall does not rapidly assume the temperature of the steam, and Professor Kirsch thinks that only the mean temperature of the wall can be learned from observation. This he would compare with the mean steam temperature, and ascertain if and how long any particular portion of the cylinder wall is dry. Though Mr. Donkin's experiments are valuable, they are not sufficient for Professor Kirsch, who would have experiments made to ascertain the behaviour of the condensed water running down the cylinder walls and how far the indicator may be relied on to give the pressure and temperature of steam in the cylinder. To do this, an engine would be fitted with various ribbed plates on the covers and two sides of the piston for catching water. These plates would be of various materials, as bismuth and copper, and the steam consumption would be noted with various plates and under exactly other similar conditions. We are not very clear why there should be any doubt as to the non-agreement of the indicated and actual pressure at any given zone of the cylinder, or how any better result would be obtained by boring small holes through the cylinder wall and fixing a manometer to register the constantly fluctuating pressure. We should think it would be of vastly more importance to endeavour to ascertain just how far there is agreement of temperature throughout the mass of steam in the cylinder, and to what extent the formation of water in the cylinder occurs on the walls and in the mass of the steam. Our own idea of cylinder condensation has always been that, so far as regards the walls, they merely condense so much steam upon their surfaces, whilst the conversion of heat into work cause the condensation of the steam in the form of mist—watery particles formed in the body of the steam. The fact that a small admixture of air will reduce cylinder condensation seems to point to the walls acting by contact, or chiefly so, and the office of the uncondensable air seems to be to form a layer upon the wall and keep the remainder of the steam from contact. It is as though a mixture of sand and shot were thrown on a fine sieve : the sand goes through and leaves the shot on the sieve, where it accumulates until it finally prevents any more sand from approaching. As a rule we think far too much is being made of this question of cylinder action. Sufficient has been determined to point to the desirability of the steam jacket when properly applied. Unless we are prepared to employ other than cast-iron or steel for the cylinder, there is not much to be done in this line beyond a determination of the effect of covering cylinder ends or pistons with some other material, a very old suggestion indeed. Cylinder condensation, which is the cause of all these curious enquiries, is simply the result of the natural endeavour of all substances to assume a uniform temperature, it is best combated by superheating or jacketing. In superheating we simply add heat to steam so that the steam may add to the temperature of the cylinder wall without itself becoming condensed. It is, however, exceedingly probable that even with superheated steam there is some condensation. The layer of steam immediately in contact with the cylinder wall does not contain sufficient superheat to yield all the heat called for by the wall, and it therefore condenses and makes room for more steam as well as furnishing a liquid heat carrier. It is not as though all the steam in the cylinder swept over all the surface and yielded up its superheat. Were this the case there would be no condensation. In practice, however, with superheated steam we have perhaps a central mass of steam, dry and superheated, surrounded by a casing of steam in various conditions up to water on the cylinder wall.

In jacketing we may have a central mass of simple saturated steam surrounded by a casing of steam of varying quality up to the cylinder wall where there may be even superheat at certain parts of the stroke. The mistake with jacketing has always been the insufficiency of the temperature. It is obvious that the working steam should not be as hot as the jacket, which ought properly to be supplied from a boiler at a higher pressure and temperature. Were jackets to be thus supplied from a special boiler it would be easy to so arrange matters that this boiler fed all its steam through the jackets into the main boilers, thereby compelling a jacket circulation, a little precaution not always observed in practice, and the neglect of which has done more than anything to discredit the steam jacket. As with superheating, jacketing may not wholly prevent condensation ; there must be some cooling, during the exhaust, of the surface of the inner walls, especially about the ports, and this cooling will be made good by the next charge of steam if not overcome from the jacket. This would point to the desirableness of thin walls in jacketed cylinders, and Prof. Kirsch's studies point to the necessity of jacketing the cylinder ends and the piston, which parts are, he says, exposed to fluctuations of temperature of double intensity and doubly prolonged as compared with the fluctuations of the middle belt of the cylinder. How rare in practice is end jacketing it needs not to tell, and yet the need for it has been clearly perceived for many years, and though investigations like these of Prof. Kirsch may give an impetus to improved methods of construction, the knowledge of the steam engine is now ahead of what has been generally attempted to be realised in construction.

OBITUARY.

[FROM OUR OWN CORRESPONDENT.]

On the 16th of this month there passed away a man who though not an electrical specialist and not known in electro-technical literature, has played an important part as regards the practical utilisation of electro-technical improvements. We refer to Theodore Puskas, the founder of the Buda-Pesth, *Telephone Herald*. Concerning the death of this man, the Buda-Pesth papers write to this effect :

"The contractor for the Buda-Pesth telephone net and originator and proprietor of the *Telephone Herald*, died this day at 9 a.m. at his residence in the Hotel Hungaria, at the age of 48. Puskas had suffered for about ten days from rheumatism of the heart, but the catastrophe was quite unexpected. Yesterday he was quite cheerful and went to bed at 9 p.m., and slept until this morning. He slept so soundly that his wife would not wake him for his breakfast, which he generally took about 8 a.m. When she returned to the chamber, half-an-hour later, she found her husband a corpse. He had departed without pain or struggle."

Puskas belonged to an eminent Transylvanian family. Scarcely had he completed his education at the Theresianum when his father died of grief, in consequence of the failure of several undertakings.

Theodore Puskas went out into the wide world with the purpose of improving the material position of his family. In London he obtained an appointment with Waring Brothers, who, in the seventies, were constructing the Hungarian North East Railway, and entrusted Puskas with its management. After finishing the construction he acquired a silver-mine in Colorado. The undertaking was successful. During Puskas's residence in America, the celebrated Keeley formed his company for developing a new source of power, and Puskas, among others, took a great number of shares. In order to set the seal on this fraud, Keeley got up an experiment before the shareholders and the representatives of the Press. Puskas was now convinced that the whole affair was a fraud, and proclaimed it as such in the papers. The inventor and his confederates offered him *three millions* (dollars, doubtless), if he would be silent. But his love of truth did not allow him to be a party to this swindle, and regardless of his own interests he unmasked the imposture in the *New York Herald*.

In New York he became acquainted with Edison, whose representative he became at the Paris Exhibition. He was also chosen chairman of the Paris Telephone Company.

The conduct of the Buda-Pesth telephonic undertaking he handed over to his brother, Franz Puskas, who held it only six years on account of his early death.

Theodore Puskas then left Paris and removed to Buda-

Pesth, where he undertook the management of the telephones. Subsequently he mortgaged the telephone net for 600,000 florins, in return for which he handed it over to the State, but leased it for 5 per cent. of the net returns. This bargain was afterwards undertaken by a joint-stock company, though all the shares remained in the possession of the Puskas family.

The management of the *Telephone Herald* has been undertaken by his brother Albert.

NOTES.

Edinburgh Electric Lighting.—Prof. Kennedy, in his report, states that an installation of the electric light can be put down in the scheduled area for £85,000.

York Electric Lighting.—The authorities contemplate carrying out certain alterations at the Art Galleries in the Exhibition Building, one of these being the electric lighting of the whole building.

Southampton Electric Lighting.—A short time since the Southampton Gas Company announced a reduction of 2d. per thousand cubic feet. The Electric Light Company now intimate that the price per unit is to be reduced from 10d. to 8d., the change taking effect from January 1st last.

Portsmouth Electric Lighting.—The electric light station in Gunwharf Road, Portsmouth, is being pushed forward with the utmost despatch, and it is hoped that the first installation in Portsmouth will be opened by the Mayor towards the close of his term of office. On the completion of the station the electric lighting machinery will be removed thither from the Town Hall, which is now illuminated by electricity. The lessee of the Theatre Royal has intimated that when the electric light is available, it will be introduced into that place of entertainment.

Silksworth Electric Lighting.—The old system of lighting by means of paraffin oil lamps at Silksworth Co-operative Store has been superseded by electric illumination. The whole of the ground and upper floors, staircase, and porch of the spacious premises are now lighted by 54 16-candle incandescent lamps, and the windows are lighted by 8 32-candle-power lamps. The Seaham Harbour Co-operative Society and others in the county of Durham, have under consideration the introduction of a new method of illumination.

The St. Louis Electric Light Convention.—The programme of the St. Louis Convention, which was opened on Tuesday, February 28th, included the following papers, &c., which were read:—Report of Committee on World's Columbian Fair; "Wrought *v.* Cast-iron for Field Magnet Frames," by A. D. Adams; "Relation of Insurance to Electric Lighting and Power," by William Brophy; "Some Experience with the Alternating System," by R. H. Sterling; Excursion to Lighting Station; "Thermal Storage for Central Stations," by Prof. George Forbes; "Long Distance Transmission of Power," by Charles S. Bradley; "Under what Conditions is the Use of Water-Power Economical?" by L. B. Stillwell; "Power Transmission for Central Stations," by Dr. Louis Bell; "Preservation of Poles and Cross Arms," by H. C. Myers; "Underground Conduits and Conductors," by W. H. Browne; "The Incandescent Lamp from a Commercial Standpoint," by Calvert Townley; "Morals of Corporations," by E. A. Armstrong; Discussion of Mr. Townley's paper; Reports of secretary and treasurer; Election of officers; Lecture by Nikola Tesla (we give this lecture elsewhere in our present issue).

Newmarket Electric Lighting.—Mr. Ed. C. De Segundo, A.M.Inst.C.E. and E.E., has sent in his report on the electric lighting of Newmarket to the holders of the Provisional Order. Mr. de Segundo estimates the cost of the necessary works for the immediate requirements at £13,000. The system recommended is a low tension one.

Church Electric Lighting.—St. Paul's (Free) Church, Glasgow, is being fitted up for the electric light.

Worcester Workhouse Electric Lighting.—The question of wiring the new buildings at the workhouse is receiving the consideration of the Building Committee.

Barrow Electric Lighting.—An Electric Lighting Committee has been appointed, and a provisional order applied for.

Falmouth Electric Lighting.—The Lighting Committee have presented their report on the question of electric lighting; they recommend its adoption.

Hackney Electric Lighting.—It has been decided by the vestry to offer £28,000 to the owners of the Pitfield Street Ironworks for this site, which is in the market. It is intended to use the site for the purposes of an electric lighting station and baths and wash-houses.

The Brighton and Rottingdean Electric Railway.—For some reason or other, this scheme has been abandoned for the present.

Carlisle Library Electric Lighting.—The Public Library Buildings are to be lighted by electricity, at an estimated cost of £1,600.

Coventry Electric Tramways.—There was some very heated discussion at the Council meeting last week, when the correspondence between Mr. Graff-Baker and the Corporation was read. The matter has again been referred to the General Works Committee.

Lewes Electric Lighting.—The Sub-Committee appointed to consider the electric lighting question have reported that there is no prospect of electric light being introduced into Lewes for a long time to come.

Lectures.—A paper was read in Glasgow before the Mining Institute of Scotland, last week, by Mr. David Hunter, on "Some Practical Results of the Application of Electricity to Mining Operations."

Clapham Junction to Paddington Electric Railway.—The House of Commons Select Committee, on Monday last, threw out the Bill for an electrical underground railway from Clapham Junction to Paddington, through Kensington, with a subway to the Albert Hall.

Cardiff Electric Lighting.—A Local Government Board enquiry was held at Cardiff last week, regarding the applications of the Cardiff Corporation for sanction to borrow £32,500 for electric lighting purposes.

Electric Lighting in Paris.—The *International Bulletin d'Electricité* has recently given figures of the present position of electric lighting in Paris, which shows the rapid progress which has been made, and the forward state of supply the French capital holds when compared with other national centres. Out of 85,000 first-class private houses, no less than 20,000 are supplied with electric lighting, while the aggregate number of lamps on the books of the various companies reaches 175,000. The maximum capacity of the supply stations is not far from 23,000 H.P., and this figure will be considerably increased when the works in hand to supply the new sector are completed.

Leicester Electric Lighting.—A very lengthy letter appeared in the *Leicester Daily Post* one day last week from the pen of "A.B.C.," in which the electric lighting of Leicester was exhaustively treated. The writer questions whether the gas committee are right in recommending the high tension system. He then proceeds to discuss the systems adopted, and the general position of electric lighting in a number of other provincial towns. It appears that Alderman Lennard objects to the consultation of an expert, but "A.B.C.," in his letter, recommends the appointment of some competent authority, and he ventures to mention the name of Mr. W. H. Preece.

Llandudno Electric Lighting.—A report was presented at last week's meeting of the Improvement Commissioners, which had been prepared by Mr. E. P. Stephenson, C.E., dealing with the electric lighting of the town. He submitted a plan regarding same, and estimated that the first cost of installation, including lands, buildings, machinery, cables, arc lamps and columns, and repairs to roads, at £15,000; annual cost of maintenance and depreciation, £1,435; cost of production, 5d. per unit; selling price, 9d. per unit.

Bromley Electric Lighting.—A Local Government Board enquiry was held last week respecting applications of the Local Board to borrow £8,175 for electric lighting purposes.

Bolton Electric Lighting.—In our last issue we gave names of the candidates for the post of electrical engineer to the Corporation. We now understand that Mr. J. H. Ryder, of Halifax, has been appointed.

Ayr Electric Lighting.—The question of electric lighting the town is in abeyance.

The Late Mr. E. T. Mercer.—Most of our readers are aware, no doubt, of the sad death of Mr. E. T. Mercer, the late manager of the Hastings and St. Leonards Electric Light Company, who was killed a few days ago on the South Eastern Railway. Unfortunately, Mr. Mercer has left a widow with four children, the youngest being only four months old. We are pleased to learn that a subscription is on foot with a view to helping the bereaved relatives. Mr. T. E. Burton, the secretary of the company, will be glad to receive subscriptions.

Ealing Electric Lighting Station.—Messrs. Bramwell and Harris have prepared a report on this scheme, in which they advocate the use of the waste heat of refuse destructors to heat the boilers. They also recommend alternating currents, and state that "the disadvantage of being unable to employ storage batteries, because of the alternating current, will not be of importance, as during the greater portion of each 24 hours the waste heat of the destructors will be sufficient to do the whole work." We, says *Industries*, are not very sanguine about the utilisation of waste heat from destructors, but even if we were, we can hardly believe that if the station develops as it ought to, the destructors will have enough waste heat to run a vigorous station at full load. Consulting engineers have evidently adopted as a creed that alternating currents cannot be used with batteries. We have for some years urged—(1) that the load factor difficulty can be overcome by using producer-gas engines, and (2) that if storage is needed for use with steam engines, it is as easy to apply it to alternating as to direct systems. All that is needed is a little extra dynamoter plant. In this case, where the waste from the destructors is going on all day, and the station must, if at all successful, soon outstrip the destructors at full load, the use of accumulators seems especially desirable.

The Barron Switch at St. Pancras.—The current number of *Electrical Plant* devotes attention to the Barron arrangement for cheap daylight supply in use on the St. Pancras circuits. Although the description is fairly correct, and is similar to what we said in our last volume when describing the switch and its uses, the cut representing the connections is not as accurate as it might be. According to our contemporary's design, the motor supply on the threepenny scale would interfere with the very principle of the arrangement; for, as shown, the whole of the lamps installed could be lit from the daylight service, thus doing away with the object for which the change over switch was put in. The minor contacts are shown equidistant from the two sets of major contacts, whereas, in reality, the minor or motor blocks, when on the higher priced supply, are in a line with the block connected to the sixpenny a unit meter.

Uppingham Electric Lighting.—It is stated that the electric light is about to be supplied in Uppingham by the Grosvenor Company.

Telegraphic Progress in Scotland. — An interesting statistical statement, illustrative of the development of the telegraph department of the Caledonian Railway Company, has been prepared. It shows that in January of the present year the mileage of telegraphic wire on the Caledonian Railway was 10,063 miles; in 1870 the mileage was only 3,597 miles. In January last the number of telegraph block-signalling, tablet, telephone, and other electrical machines in stations, signal-boxes, &c., was 6,076; in 1870 there were only 412. It will thus be seen that no less than 15 times the quantity of appliances required 20 years ago are now employed in the signalling and working of trains and traffic. The bulk of the increase has been brought about by the introduction of block, train tablet, and other appliances, to ensure safety in the working of trains and in the conveyance of passengers. The number of battery cells provided to work the railway electrical appliances is 39,700; in 1870, 2,884 were sufficient. In 1892 the number of business telegrams forwarded from stations on the company's wires was 1,106,278. These messages averaged about 20 words each, representing, at the public rate of ½d. per word, the sum of £46,120. Telephonic messages, which are not included, would bring the total up to £50,000. Train departures signalled from station to station and signal-box to signal-box, are not included, but number many millions. At the central station, Glasgow, the company manufactures its own light, and the amount required in the block, including the station, hotel, and archways, is equal to a gas consumpt of between 30 and 40 million cubic feet per annum, or as much as would be required to light a residential population of over 30,000. Electric light has been substituted for every gas jet in the block from the lowest cellar to the clock tower. The Grangemouth Docks of the Caledonian Company are also lighted by the same illuminant. The telegraph department of the company are now laying down plant for electrically lighting the new Princes Street Station, Edinburgh.

Sunderland Asylum Electric Lighting.—Mr. A. A. C. Swinton in his report respecting the lighting of the New Lunatic Asylum at Ryhope, estimates (says the *Sunderland Herald and Daily Post*) that 54,658 units would be required to efficiently light the asylum. The cost of coal was placed at £228 per annum, or 1d. per unit, engineers' wages were put down at £78, oil, waste, &c., at £30, renewals at £60, and repairs at £100, being an annual cost for electricity of £496. The consumption of gas was calculated at 840,900 hours, during which 16 candle-power lamps would be lighted, each lamp consuming eight cubic feet of gas, or a total per annum of 6,720,000 cubic feet. The gas company demanded 2s. per 1,000 cubic feet, or 6d. per 1,000 more than the Corporation pays within the borough boundary, which was equal to an annual cost for gas of £672. According to Mr. Swinton's estimate, therefore, the cost of electricity is to be about one-quarter less than gas at 2s. per 1,000.

Yarmouth Electric Lighting.—At the monthly meeting of the Yarmouth Town Council, held on Tuesday, last week, the subject of the electric lighting of the borough, at an estimated cost of £15,000, was the principal matter under discussion. Resolutions as adopted at a town's meeting and at a meeting of the Ratepayers' Association, protesting against the scheme, were submitted. The Chairman of the Electric Lighting Committee launched the subject by moving the adoption of the committee's report, which recommended that the scheme should be carried out without loss of time for lighting the town by electricity, under the direction of Mr. W. H. Preeece. The Borough Surveyor, replying to a question from the council, said in addition to the lights necessary for the illumination of the town, about 2,000 private lamps, he estimated, would be at once applied for. Mr. A. Peaton moved an amendment that the report should be referred back to the committee for reconsideration, with a view to the preparation of a modified scheme. The amendment was lost, the original motion being carried.

Pembroke Dockyard Electric Lighting.—It is highly probable that the Admiralty will shortly take steps to introduce electric light at Pembroke Dockyard. An experiment in that direction has been for some time under contemplation.

Watford Electric Lighting.—It was reported at the last meeting of the Local Board that Messrs. J. G. Statter and Co. had written, saying that it had been proposed to form in Watford a company for lighting the town with electricity. The company indeed had been formed, although it had not yet obtained a provisional order. The Earl of Essex had consented to become president. Mr. J. G. Statter had viewed the place and reported that there was every prospect of the movement being a success. They proposed to conduct all their wires underground in the principal streets, and in no case would they carry them overhead without consulting the board. The chairman of the board said the company had simply given them notice they would apply for a provisional order, and the board had better instruct the clerk to advise on the matter. This course was adopted.

Huddersfield Electric Lighting.—At last meetings of the County Borough Council it was asked when the outside districts were likely to get electric light? The Mayor believed that the inside districts would be supplied about July or August, and the outside districts, he, supposed, when they paid for it.

Manchester Electric Lighting.—The chairman of the Moss Side Local Board has been making enquiries regarding the electric lighting of the district.

Electrolysis and the Purification of Lead.—An ingenious application of electrolysis has recently been made in the purification of lead and the recovery of silver from argentiferous lead, which results in the production of chlorine—a gas which can be most advantageously employed in chemical manufactures. The chlorides of calcium and magnesium are decomposed with lead nitrate, and the lead chloride so formed is utilised for the electrolytic production of chlorine, whilst the nitrates of calcium and magnesium, which are also the results of the decomposition, are heated for the recovery of nitric acid, which is used for dissolving fresh quantities of crude oxidised lead to form lead nitrate. Silver, and other metals, may be precipitated from this solution by the addition of spongy lead. As an alternative way of working, hydrochloric acid is used instead of the chlorides for decomposing lead nitrate (or acetate), the products being lead chloride and free nitric acid, which may be used, as before, for dissolving fresh quantities of previously oxidised lead. The fused chloride is, according to the process, which has now been made practical by F. M. and C. H. Lyte, electrolysed in a glazed earthenware or enamelled iron vessel kept at a suitable temperature. The cell is closed on the top, and is provided with a feed pipe for the lead chloride, a chlorine outlet pipe, and a syphon for drawing off the purified molten lead. The carbon electrodes—alternately anodes and cathodes—are securely fastened to the lid. In another arrangement the carbon plates are all anodes, the molten lead forming the cathode. The conductivity of the carbon electrodes may be improved by making them with a core of iron or other metal in the form of a plain, corrugated, or perforated plate.

An Electrical Couple in the Dye-Vat.—Large quantities of woollen and other goods are dyed in copper pans, and it is well known that in many cases the metal has a more or less deleterious effect upon the brightness of the shades. By coating the interior of the pans with tin, this disadvantage may be prevented; but this device is costly, and when the tin is worn off, it is often very inconvenient to have the vessels re-lined. The difficulty has now been successfully overcome, in a most inexpensive manner, by an application of an electrical principle. The remedy simply consists in bringing in contact with the copper a number of strips of sheet zinc, of such dimensions, that about one-fifth of the surface of the copper is in contact with the zinc. These two metals form an electrical couple, which absolutely prevents any copper from getting into solution and injuring the dye. As the zinc strips wear out, they are replaced by new ones, an operation which can always be performed within a minute or so, thus involving no serious inconvenience to the continuity of the dyeing operations.

The Mansion House Electric Lighting.—There was a long discussion in the Court of Common Council last week on the cost of the electric light at the Mansion House, which was stated to be likely to amount to £1,100 a year; and the committee in charge of the matter have reported that as regards the painted windows, after making illuminating experiments with electric lights, they recommend that the old system of gas be reverted to.

CONTRACTS OPEN AND CLOSED.

OPEN.

Brighton.—April 4th. Supply and erection of electric arc lamps, switches, &c.

CLOSED.

Derry.—In connection with the scheme for lighting Derry city by electricity, we understand that the tender of Messrs. Alexander Brown and Sons, at £4,293, has been accepted for boilers, fuel, economisers, engines, condensers, and travelling crane, feed pumps, steam pipes, &c., water tanks, connections, and lamp pillars. The tender of Messrs. Siemens Bros. & Co., at £8,905, has been accepted for dynamos, regulators, switchboard, Brockie-Pell arc lamps, lamp carriers, and underground conductors.

BUSINESS NOTICES, &c.

Roger Dawson, Limited.—The business of Mr. Roger Dawson, of 53, Berners Street, was made into a limited liability company, not with a view to appealing to the public for capital but to suit the convenience of family and personal friends who are interested in the business. As a result of the change Mr. A. R. Cobbett, formerly the active partner of the firm of Arthur Cobbett & Son, of 18 and 19, Pall Mall, a gentleman of extensive and successful business experience, becomes a co-director with Mr. Dawson, the former controlling the non-technical departments of the business and the latter taking the superintendence of the manufactory and the execution of work. We understand that the manufacture of artistic fittings to the trade is to be made, even more than in the past, a most important feature of the business, the factory in Stanhope Street affording scope for large development in this direction.

Lists, &c.—Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, have sent us a copy of their February issue of price list of dynamos, motors, &c. Our special attention is attracted to several points in the book. There are some important reductions noticeable in prices of the machines. The chief machines, to descriptions of which space is devoted, are the "Castle" dynamo, Holmes-Willan's system Castle dynamo, with drum bar armature; slow speed coupled direct system; "Castle" electric motors, projectors, switches, &c.

The India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, have brought out another price list (No. 40) of electric light cables and wires. We have much pleasure in recommending this to our readers' attention.

New Books.—Messrs. Whittaker & Co. will issue in their Specialists' Series a work on "The Dynamo," by C. C. Hawkins and F. Wallis, and a new edition of Sir David Salomons's work on "The Management of Accumulators." They have also in preparation in the Library of Popular Science an introductory work on "Electricity and Magnetism," by S. Bottone. Mr. W. Perren Maycock has completed the second part of his work on "Electric Lighting and Power Distribution," and it will be issued in a few days. Mr. Bottone's little popular "Guide to Electric Lighting," has rapidly passed through a first edition, and a second will be issued shortly.

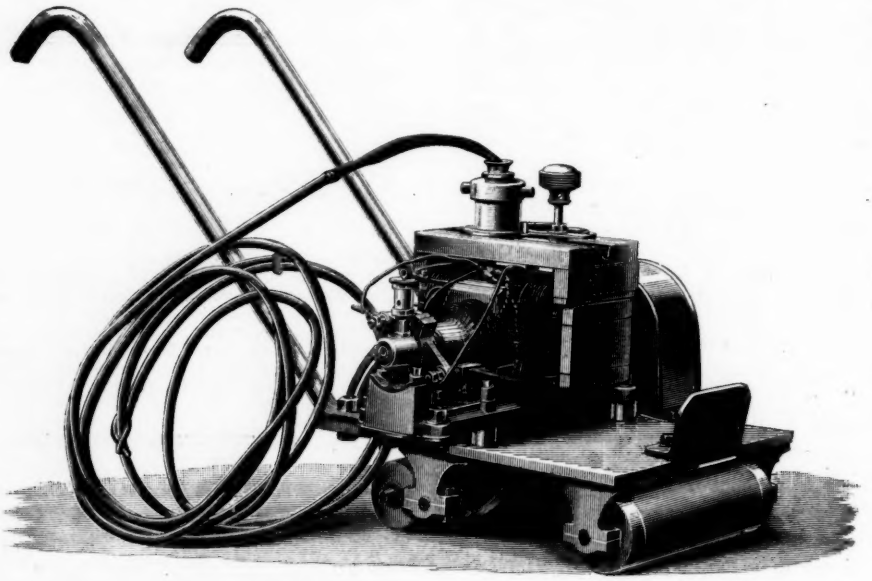
Burnley Electric Lighting.—In our last issue under this heading we stated that Messrs. Kennedy & Cook had secured the contracts for lighting by electricity the Town Hall and the Mayor's new residence. We are, however, informed that the work is really being carried out by Messrs. Spagnoletti & Crookes, who ask us to insert a correction to this effect. The error in the names originally appeared in the *Burnley Gazette*, for 4th inst., from which source we obtained our information. We understand that Messrs. Spagnoletti have had about 20 or 25 men employed on these two installations for some weeks.

Removals.—Having found their present Dowgate Hill premises too small for their requirements, Messrs. George Smith and Co. intimate that they have secured ample accommodation at 199, Upper Thames Street, E.C., whither their City office will be removed on 15th instant.

The registered office of the United River Plate Telephone Company, Limited, has been removed from 53, New Broad Street, to 340, Dashwood House, Old Broad Street, E.C.

New Business.—Messrs. Hurry & Young have taken premises at 16, Princes Street, Edinburgh, for the purpose of carrying on business as electrical engineers and contractors.

A New Electric Tool.—The use of electricity for transmitting power has been steadily increasing during the last few years. Not only is it often found better than mechanical transmission, but in many cases it enables mechanical power to be applied to work, where, without electricity, it would be quite impracticable to use anything but hand-power. One of the latest machines of the latter kind is an electric deck-planer, invented and patented by Mr. Malcolm Sutherland, electrical engineer to Messrs. W. Denny & Brothers, the well known shipbuilders of Dumbarton. The illustration shows one made by that firm, and used by them for planing the decks of the ships they build. It is so simple in construction that very little explanation is necessary. It resembles a lawn mower in form and is handled in the same way, and with as much ease. A steel base-plate is mounted on rollers, and on the underside of this the revolving cutter is fixed. The electric motor is placed on top, and is geared to the cutter by means of toothed wheels. The latter is one of Rawlin's spiral cutters, and revolves at a speed of 3,000 revolutions per minute, the motor having a speed of 2,000 per minute. The hind rollers which follow in the cut are fitted with eccentric journals, so that by moving a lever, they can be raised or lowered, and the depth of cut nicely adjusted. It does very good work, is faster than hand-planing, and relieves the men of a very disagreeable job, as the planing of decks by hand involves kneeling or sitting in a very uncomfortable position. Current is supplied to the motor by means of a twin flexible lead, and the whole machine is of a very compact and portable nature.



Telephonic Entertainment.—On Monday evening last Mr. P. P. Kipping, by kind permission of the National Telephone Company, gave an interesting entertainment at the Lecture Hall of the Highbury Quadrant Church. Mr. Goring Thomas's new opera "The Golden Web," now being performed at the Lyric Theatre, was most successfully transmitted to the hall, and distinctly heard by the audience. At intervals during the evening cornet solos and recitations were equally well transmitted from Birmingham. The latest intelligence on home and foreign affairs was received from the offices of the Central News by telephone, and distributed throughout the hall by means of column printing telegraphs. Telephonic and telegraphic apparatus were fitted up in the hall and caused much amusement. In consequence of a large number of persons being unable to obtain admission, owing to a crowded audience, this entertainment will be repeated this (Friday) evening.

Personal.—We have much pleasure in congratulating Mr. George Sutton on the promotion just conferred upon him by the directors of W. T. Henley's Telegraph Company, of which company he was, until very recently, secretary. According to what the chairman said at last Friday's meeting at Cannon Street Hotel, Mr. Sutton's services are almost indispensable to the company, and to show their appreciation of these, the directors have elected him to a seat on the board, as they are empowered to do under the articles of association. Mr. Sutton is relieved of his former secretarial duties, although he remains responsible for their efficient execution, and he now acts in the capacity of managing director.

The Epstein Electric Accumulator Company, Limited, announce that Mr. Frederick R. Bluett has been appointed secretary to the company, and that the offices are now at 213, Gresham House, Old Broad Street, E.C.

The Electric Light in Sheffield Omnibuses.—Mr. Reuben Thompson has applied the electric light to a couple of his omnibuses on the Brocco Bank route. This is said to be by way of experiment. The fittings have been supplied by Mr. T. Scott Anderson, electrical engineer, of 59, Wilkinson Street.

The Electric Lighting of Craig-y-Nos Castle.—In our issue of 10th inst., we notified that Messrs. Bergtheil & Young were carrying out the installation of the electric light at Madame Patti Nicolini's residence, Craig-y-Nos Castle, South Wales. We are informed by the contractors that the work is considerably more extensive than would appear from our notice, in which we state the cost to be £250. The *South Wales Daily News* is responsible for the statement, as the information was first published in the columns of that paper.

CITY NOTES.

Elmore's French Copper Company, Limited.

To the Shareholders in the Elmore French Patent Copper-Depositing Company, Limited, who Subscribed to the Cost of the Preliminary Investigation.

Gentlemen,—We have now received from Mr. W. J. Burnside a statement of the financial affairs of this company, and from Mr. Le Neve Foster the enclosed report on the works at Dives.

Mr. Burnside's statement is founded mainly on a report from the auditors of the company which was supplied to us on March 9th, showing the details of receipts and expenditure up to December 31st last. Since that date the books of the company have not been posted.

The auditors' accounts show that the sale of manufactured copper, &c., for the seven months from June 1st to December 31st, 1892, amounted to £7,901 6s. 5d.; that the actual loss on manufacture was £5,187 6s. 1d., and that the total working loss on the seven months, including interest and general expenses, has been £18,163 0s. 4d.

	£ s. d.	£ s. d.
The cash liabilities of the company on December 31st are stated to be...	£92,355 8 1	
To which has to be added 6 per cent. redeemable mortgage debenture stock	38,000 0 0	
Total cash liabilities		...£130,355 8 1
Other liabilities—		
Preference shares...	£42,788 10 0	
Ordinary shares	133,265 6 0	
" Vendors' shares ...	66,500 0 0	
		242,553 16 0
Additional receipts on capital account—		
Premium on issue of ordinary shares	£33,375 0 0	
Receipts on shares before forfeiture	8 0 0	
		33,383 0 0
		£406,292 4 1

We have no means of ascertaining how much the liabilities have been increased since December 31st, 1892. On applying to the secretary of the company for information, he writes as follows on March 14th:—

"It would be almost entirely guess-work for me to estimate what had been the company's loss in working since January 1st up to this date, but I think I am safe in saying that it would not be in proportion to the loss shown in 1892 balance-sheet, inasmuch as the output and the sales have been larger, and many of the expenses incurred in 1892 have been altogether avoided in the present year."

When it came to our knowledge that the liabilities of the company were so large, and the working loss so great, we wrote to the directors, pointing out that they would incur a serious responsibility if they borrowed to pay off the debts of the company, as such a proceeding might be regarded as preference payments, which in the critical position of the company should not be made.

It is clear that the enormous discrepancy between the representations on which the company was founded and the working results must become the subject of further investigation. The immediate subject for consideration is what steps can be taken to protect the property of the company, and to test the possibility of working at a profit.

It is obvious that the company must no longer be exposed to the claims of the cash creditors, or subjected to the heavy charges which are now imposed upon it.

Mr. Le Neve Foster states that the works as they now stand, or with a very small outlay, are capable of treating 100 tons of copper per month, and he is of opinion that a manufacturing profit of £25 per ton, or £2,500 per month, should be realised.

It seems difficult to understand how so large a manufacturing profit as Mr. Foster estimates can be obtained in the face of the unsatisfactory results of the seven months' working, of which we have the accounts, but from these profits, if realised, would have to be deducted the general charges on the business, including interest, and if these charges are as heavy in the future as in the past they will absorb the manufacturing profit.

It will, we fear, be found that at the present time the general charges are greater than last year, rather than less, as we are informed that money has been borrowed at up to 33 per cent. interest to meet pressing demands.

It appears to us that the business, as now conducted, must come to an abrupt termination, with heavy loss to all concerned, unless some definite steps are taken by the shareholders.

Our duty is fulfilled by placing the facts before you, and arranging, as promised, for a meeting of the subscribing shareholders. This meeting we propose to hold at the Cannon Street Hotel on Wednesday, the 22nd inst., at 2 o'clock p.m.

In cases where a shareholder is unable to attend personally, an authorised representative will be admitted on presenting the enclosed card duly signed.

WILLIAM SAUNDERS.
SAMUEL STOREY.

Note by Sir T. H. Farrer.

I have joined Mr. Saunders and Mr. Storey in procuring the accompanying report of Mr. Arthur Le Neve Foster on the French Elmore Company's works at Dives, and also in obtaining, through Mr. Burnside, figures extracted by him from the printed accounts of the company; but I do not wish to take any responsibility in the matter beyond laying the above report and figures before the shareholders for their consideration. The complete investigation of the accounts of the company is a matter requiring much more time and knowledge than I can give to it.

REPORT ON THE WORKS AT DIVES, BY MR. A. LE NEVE FOSTER.

In accordance with your request, I have visited the company's works at Dives and carefully examined everything in connection with the manufacturing business, and have the pleasure to report to you as follows:—

The works are of a substantial character, well built, and apparently suitable for the manufacture for which they have been designed. They appear to have been constructed in a somewhat costly manner, more especially as far as the plant is concerned.

The works and plant have been erected for a monthly output of some 300 tons. The engines and dynamos are in duplicate and triplicate, and on a very extensive scale. Up to the present time the output has been comparatively small, hence this plant has been worked at a great disadvantage.

The system of construction and working of the deposition tanks with their electrical and mechanical arrangements (this being the part embraced by the Elmore patents) were presumably constructed in accordance with Mr. Elmore's advice, aided by the experience gained by the French Company from the costly experimental work done in Paris. However, on the manufacturing at Dives being commenced, great alterations had to be made to the machinery before marketable tubes could be produced by the Elmore process.

The apparatus first erected for giving motion to the mandrils in the depositing tanks caused considerable trouble, and had to be entirely re-modelled before continuous working could be carried on. A large number of the tanks are still fitted with the old gear, which will require altering before the tanks can be used. The new driving gear has, I believe, been patented by M. Secretan in France, and is a marked improvement on the original plan. The original burnishers were found unsatisfactory, and new arrangements for these had also to be constructed. When it is remembered that the mechanical machinery for the entire 264 depositing tanks, covering a floor space of some 60 by 90 yards, had to be completely re-modelled, much of which there still remains to be done, it must necessitate a heavy outlay. This outlay could have been avoided had ordinary caution been exercised, and the plant in the first instance tried on a less extensive scale.

I gather from M. Secretan and others, at Dives, that the system was constantly breaking down, and had in a great measure to be reconstructed before anything like saleable tubes could be produced.

To-day the capabilities of the depositing tanks that are in working order are equal to some two tons per day of 24 hours. The remaining plant requires considerable alterations and outlay before they are capable of producing the 300 tons per month, for which they were originally designed.

These facts would seem to be inconsistent with the prospectus of the company, from which it would be presumed that the experimental stage had been passed.

An extensive plant has been erected for the manufacture of copper plates, and also for wire drawing. This seemed to me to be undesirable, as the margin of profit on this manufacture is very low when compared with tubes. At the time of my visit neither the manufacture of plates or wire had been started.

The electrical arrangements, as before mentioned, were planned for an output of 300 tons per month, consequently are now being worked most uneconomically.

A very serviceable plant has been put down for drawing the tubes, by which means they can greatly reduce the cost of expensive mandrils that would otherwise be required for manufacture under the Elmore process.

The plan of subjecting the tubes to the drawing process was, I believe, when first erected, objected to by Mr. Elmore as unnecessary. Had this plant not been put down, the orders that have already been executed by the company could never have been undertaken. The drawing is done at comparatively small cost, and obviates delays in execution of orders. It allows the depositing tanks to be worked constantly on certain stock sizes, facilitating greatly the electrical arrangements, whilst at the same time it improves the quality of the copper.

The following estimated cost of production is for an output of 60 and 100 tons per month. My estimate is calculated upon the expenses at the works only, not including any allowance for depreciation, interest on money expended in patents, renewals and repairs of buildings and plant, &c., rent, taxes and expenses in Paris and London. The expenditure is based upon the figures I obtained from the books at the works. An expenditure of £1,200 per month for salaries, wages, coal and sundry materials, but excluding the cost of raw copper, should prove sufficient, with judicious management, to cover a steady output of 100 tons per month. With the smaller output of 60 tons there would be little, if any, saving with the present arrangements.

To these calculations I have added the value of silver and gold that may be found in the sludge of the depositing tanks. The value of this depends entirely upon the nature of the ingot copper treated. If suitable argentiferous brands of copper are used, and careful means are adopted to collect this sludge, the additional profit may readily reach as much as £7 per ton of copper treated, or even more.

It is presumed in these calculations that a steady sale can be effected of the quantities in question.

ESTIMATE OF MANUFACTURING GROSS PROFIT.

Tons of raw copper treated per month.	Cost of copper, manufacturing expenses, salaries, wages, &c., per month.	Cost per ton, including raw copper.	Gross manufacturing profit, including an estimated value of gold and silver recoverable of £7 per ton.
Tons.	£	£	£ s.
60	3,960	66	16 15
100	5,800	58	25 15

In above estimate raw copper is taken at £46 per ton, sale price of tubes at £80, and of electro-deposited scrap copper at £50.

In working the Elmore system as the plant is at present arranged, it is most important that a regular output from the depositing tanks be maintained, and my figures are based upon this assumption.

The manufactured copper tubes that I inspected and tested were of excellent quality, and certainly superior to ordinary commercial solid drawn tubes, and should command a ready sale at market prices.

The organisation of the works at Dives was good, and the heads of departments appear to be thoroughly competent men.

For works of this size the monthly expenditure is by no means excessive, whilst the administration expenses at both London and Paris appear to me to be out of all proportion to the small amount of copper that has been treated, or even for a much larger output.

Respecting the value of the works at Dives, it would have been impossible for me, with the time that was at my disposal, to arrive at anything like a fair valuation, but it is very certain that in the event of a forced sale they would realise very little indeed in comparison to the immense sums expended on them.

The Elmore system, when purchased by the company, appears to have been far from perfect, and had this fact been realised prior to the construction of the works, the heavy expenditure of the shareholders' money, incurred with conspicuous lavishness, would have been avoided.

I am, Gentlemen,
Yours faithfully,
A. LE NEVE FOSTER.

A meeting was held on Wednesday afternoon last at Cannon Street Hotel, of the shareholders who had subscribed to the preliminary inquiry instituted by Sir Thomas Farrer, Bart., William Saunders, M.P., and Samuel Storey, M.P. Mr. Samuel Storey, M.P., presided.

The CHAIRMAN: The circumstances under which we meet are familiar, and therefore need not be dwelt upon, I will merely state them. Some of us shareholders were dissatisfied with many matters relating to the French Elmore Company: our dissatisfaction pointed in four directions. First of all, we were dissatisfied with the

absolute non-fulfilment of the very rosy promises made originally, and at a later time. Secondly, we felt a businesslike objection to the method in which the works had been laid out for an enormous output before there had been practical proof that a similar output could be produced with profit. Thirdly, we were horrified to see the admitted loss on working during the months of last year when the works were busy; and, fourthly, we were brought to bay by the fact that the directors evidently admitted that it is absolutely impossible to go on unless they could get a large sum of money which he might practically put at £50,000. Well, that being their state of mind, Sir Thomas Farrer, Mr. Saunders, and himself took upon themselves as shareholders, to send out a circular and ask every shareholder to join them and ascertain for themselves what facts they could, and he was glad to say the response was immediate, very hearty, and very numerous, and in consequence of the small but sufficient funds that were placed at their disposal they got Mr. Burnside to make them a financial and general report on affairs, and they sent Mr. Le Neve Foster to France that he might see for himself and report as to the works. They, upon receiving those reports from Mr. Burnside and Mr. Foster, also made a report for themselves, and he believed that that statement had gone to every gentleman present, and inasmuch as it had so gone, he assumed, they would take it as read. He stated that the committee in this matter had acted in a perfectly above-board fashion. They had not gone behind the directors, or assumed that they were wicked men who had wilfully done wrong. They put themselves into communication with them, and he was glad to be able to say that they had found the greatest willingness on the part of Major Jones and his *confrères* to give them all the information they could. He then moved that the circular letters of Sir Thomas Farrer, and Mr. Saunders and Mr. Storey, be taken as read.

This was unanimously carried.

He then also put it to the meeting that Mr. Le Neve Foster's letter be also taken as read.

This was likewise unanimously carried.

The CHAIRMAN then called upon Mr. Burnside's assistant to read that gentleman's report with great deliberation and slowness, and he called the meeting's special attention to that report.

The following report was then read:—

"In consequence of pressing applications from the Board of Directors for financial assistance, you issued, on the 23rd February, a circular letter to the shareholders, suggesting the advisability of making an independent and preliminary investigation of the affairs of the Company. In reply to this, numerous letters, expressive of approval, enclosing contributions, at the rate of 1d. per share, amounting at the present to over £140, were received towards the expenses. The co-operation of Mr. Arthur Le Neve Foster, an experienced engineer and electrician, who speaks French fluently, and who has had great experience in the management of large works, was secured, and he proceeded to France and there investigated, so far as possible, the position of affairs: and his report is now submitted herewith. With the assistance of Mr. Robertson, accountant, of Messrs. Good, Son & Co., Moorgate Street, I examined, so far as time and the materials placed at my disposal would permit, the statements of accounts issued, and find that:—For the first 21 months, ending May 31st, 1892, no start was made in actual manufacturing, yet during that period cash was expended, besides the expenditure on capital account as follows:—

	£	s.	d.
For experimental purposes, perfecting of process, administration and interest charges, &c.	41,322	5	2
In addition to this, the expense of issue of preference share capital, &c., amounting to	3,473	1	5
Total	£44,795	6	7
The latest accounts, as supplied by the auditors on the 9th inst., show a loss on manufacture, during the seven months ending December 31st, 1892, of £5,187 6s. 1d., and after adding general expenses and interest, deducting certain credits of £346, the working loss on the 7 months amounts to	18,163	0	4
This makes a total loss on current expenses for the 28 months of	62,958	6	11

"In the absence of the Paris books, the items of expenditure incurred for administration, and for experimental purposes before the actual working commenced, on the 1st June last, amounting to £41,322, call for explanation. Some of the items are:—

	£	s.	d.
Directors' fees	2,689	0	0
Law and professional charges	2,676	0	0
London salaries	1,258	0	0
Salary of director-general at Paris	1,980	0	0
Fees of committee of directors	1,320	0	0
Salaries of staff in Paris	2,096	0	0
Wages of workmen at Dives	7,030	0	0
Fires and stores, Dives...	3,490	0	0
Travelling expenses, Paris office	625	0	0
Do. do., London office	398	0	0
Salaries and travelling expenses, Dives ...	3,082	0	0
Stationery, printing, postages, telegrams, and general charges—			
Dives, Paris and London	2,410	0	0
	£29,054	0	0

"This expenditure is included in the above sum of £41,322 entered on the balance-sheet as an asset or expenditure on capital; the difference between the two amounts being composed of interest, commission, &c. (£7,165), rent on water-power, Bellegarde (£750), and sundry minor charges.

			£	s.	d.
The company received, in actual cash, up to Dec. 31st last			306,416	0	0
Made up as follows:—					
Ordinary shares	133,265	0 0			
Preference shares	42,788	0 0			
On forfeited shares... ...	8	0 0			
Six per cent. debenture stock, less £12,000 redeemed, but since pledged as collateral security for part of the £92,000 referred to below...	38,000	0 0			
			214,061	0	0
To which must be added amount of credit received by way of loans, bills payable, and sundry creditors			92,355	0	0
			£306,416	0	0
Sale of license to manufacturer of copper wire			9,500	0	0
Total			£315,916	0	0

This cash is thus accounted for:—

Cost of patents, in cash	83,500	0	0
Land and erection of works at Dives, plant, machinery and furniture	137,264	0	0
Land at Bellegarde	5,270	0	0
Office furniture, Paris	522	0	0
Stock of copper	15,680	0	0
Stores	5,403	0	0
Cash at bank and in hand	2,210	0	0
Sundry debtors and contractors	3,109	0	0
	£252,958	0	0
Unreturnable expenditure since the formation of the company, being loss	62,958	0	0
	£315,916	0	0

"On September 16th last, Mr. John E. Stafford, A.M.I.C.E., valued the land, buildings, machinery, and stock at Dives at £112,832. These assets in the balance-sheet of December 31st, 1892, are valued at £158,347.

"The other assets on December 31st consisted of:—

Land at Bellegarde, which cost	£5,270	0	0
Office furniture	522	0	0
Sundry debtors, &c.	3,109	0	0
Cash	2,210	0	0
	£11,111	0	0

"In the prospectus of September 10th, 1890, great stress was laid on the exceptionally cheap driving power acquired by the company for the purposes of the proposed works at Bellegarde, under an agreement with the Rhone Land and Water Power Company, for a supply of 600 horse-power to work night and day. This, it was urged, would obviate all initial outlay and the expense of erecting engines and boilers, with the additional advantage of being able to commence operations without loss of time. This land, with the water-power, has not been put to any use whatever, although the rental began October 1st, 1891, is now £3,000 a year, and cannot be determined until March 25th, 1894. It was further stated in the prospectus that, considering the great extent to which copper is used in France, the higher price paid for copper articles there, and the reduction in working expenses, owing to the arrangement as regarded power made with the Rhone Land Company, the shares in the present company would favourably compare with the English company, the £2 shares of which were then quoted at £8 each. Beyond the auditors' accounts issued up to May 31st and December 31st, 1892, respectively, which were not received by me until the 9th March, there has been practically nothing for the accountant to investigate, the London books having been only made up to the end of the year, and then simply recording the remittances to France, without giving details. The various items have therefore had to be taken *en bloc*. It would have been better if daily reports had been sent from Paris to London, giving particulars of orders, cash received and goods invoiced; with weekly reports showing stock, cash balances, expenditure and liabilities incurred. The liabilities have been increased since December 31st last (1) By acceptances of £27,000 still current, granted on payment of £23,000 due to certain creditors on December 31st. (2) By the rent of the unused water-power at Bellegarde, at the rate of £3,000 per annum. (3) By the probable continued loss on the trading since December 31st, the amount of which is not yet known; and (4) by the administration charges since that period, in London, Paris, and in Dives, the amount of which cannot at present be ascertained. An item calling for explanation is a sum of £1,000. credited in the first proof of the auditors' account of December 31st last, sent to me, as due by 'The Phœnix Trust, in Liquidation.' 'for Accommodation Bills accepted on their account' (but which is

omitted in the final proof, though the totals in both proofs are the same); and such explanation is the more necessary, as it is not shown under what authority this liability was incurred.

"The law charges were mainly incurred in procuring the mortgage for £95,000, held by the parent company over the present company's works, in trust, as to £50,000, for the debenture holders, and as to £45,000, to cover a second charge for advances.

"There is also, I understand, a considerable amount payable in December next as part of the purchase money of the company's land, but of this no notice appears to have been taken in the accounts furnished. I understand that the auditors have made a report which probably gives considerable information as to the position and prospects of the company, but though applied for early on the morning of Saturday, the 11th inst., the secretary has hitherto been unable to furnish a copy. From the foregoing it will be seen that the promises in the prospectus have not been realised, the working capital of £50,000, stated at the date of its issue to be sufficient, has been increased to £143,000, and this has been so far short of the company's requirements as to necessitate incurring further liabilities of £80,000, and yet it is now said that no progress can be made without additional capital for working purposes. The position of the company is indicated by the fact that during the past month acceptances have been given to creditors for £8,000, on which the interest works out an average of 33 per cent. It is evident that the business of the company cannot be carried on under such conditions. The chairman and the secretary have stated that the company must go into liquidation unless further funds are immediately procured. I would suggest that the committee call a meeting of the subscribing shareholders, so that they may decide as to the course to be pursued on hearing the facts.

"WM. J. BURNSIDE."

The CHAIRMAN here read a letter from Mr. F. L. Rawson (Mr. Rawson protesting because the contents of the letter were sent confidentially), omitting the names therein mentioned. The letter stated that the writer had been looking into the possibilities of reconstruction, and had been staggered to find that this was practically impossible considering their position in France. The only way, he said, of saving their money would be in keeping the existing company alive, forcing the creditors to come to terms, and raising the necessary money on debentures, paying out the French creditors when they, later on, would be able to make a reconstruction scheme, if necessary, without having difficulties in France. He also read another letter which was from Mr. W. Elmore, referring to the report of Mr. Foster. He stated that the French company's plant was not laid down to design supplied by him; the statement was absolutely without foundation. It was distinctly untrue to say that the Elmore process was not a satisfactory workable process, if carried out in accordance with his instructions. He was prepared to prove that the Elmore process operated in accordance with his instructions, and with plans identical to those supplied to the French company, had been in successful operation on a scale of considerable magnitude, producing goods of the best quality. The chairman said he thought he had better read that letter, although it did not help them at the present stage of their proceedings. He really thought that as one of themselves—their unfortunate selves—there was much that he could say to them. What they ought to do, as business men, was not so much to indulge in complaints and condemnation as to the past, although the time might come when that would be necessary, but rather as common-sense men address themselves to the problem how they could make the best of the future. First of all he would put it in this way, and he hoped they would not think he was imitating a great statesman when he did so. There were three courses, and three only open to them at the present time. The first was to go on, that was the advice which Mr. Rawson had given to them, that was the advice which the directors would fain give to them, that was the advice he would tender to the meeting if he could be satisfied on two points: first, where was the money to be got to go on with, and secondly, what reasonable business guarantee was there that if it were got it could be effectually used so as to effect profits. He spoke to gentlemen who might be prepared to find the money. He hoped Mr. Rawson would give them a good handsome sum, and Mr. Elmore too, but he might be prepared to differ from them, and if they could find the money, and could go on, he would like to ask the question, "How does it happen that this money is wanted?" Mr. Burnside had put the thing very clearly, and he (the chairman) thought he would interpret his statement thus:—The money is wanted at the present moment because the money already supplied had been grossly mismanaged and wasted (hear! hear!). There was only one observation he would make. He would make two quotations in support of that. They had been looking through the statements made when the original company was formed; and at a much more recent period there was a meeting—he referred to the report of the first general meeting on the 9th January, 1891, and he would like to read to them what the chairman (not the chairman at the present time) said then. He stated—these are not his words—that the Board had raised £50,000 additional capital on six per cent. debentures issued to the parent company in order to carry out M. Secretan's suggestion as to increased plant capable of producing 300 tons per month. That would raise the working capital to £100,000, and, the chairman stated, would avoid the necessity of applying to the shareholders for any additional capital. M. Secretan, in his speech, stated that within three months (from January, 1891) he would be in a position to turn out 370 tons of copper articles per month, the sale of which was absolutely sure, that was a firm and strong statement. Then on the 1st January, 1892, in the circular addressed to the chairman it was stated that the works were completed capable of carrying out eighty to ninety tons per week, which was practically the same as 370 tons per month. The manager was very enthusiastic about the financial results, and stated that the demands far exceeded the total output of the works. If there had been any sort of truth in that statement they would not have been in the difficulty they were in now. Fourteen tons, he was told, was the largest quantity they had ever been able to get out of the works. He said, therefore, that unless the gentlemen concerned were bad business men, and men not to be trusted in business—although they might be trusted in other ways—he must say different results would have been achieved. He would make one or two observations about M. Secretan, for his name would crop up. He did not know M. Secretan, he had no doubt he might be a clever man, but he would undertake to say he was not a business man at all, and he would tell him that the reason why they wanted the money at the present time was this: If you and I go into a business about which there is no doubt, we go like any sensible Englishmen, slowly and surely; they put down a portion of the plant, and when they had satisfied themselves that it would be efficient and get profits, then they could go on to extend; but M. Secretan and the directors had done this—they had put down a huge plant which in practice they had never been able to use, and the two felt effects of that were, first, that the money which they now needed for working purposes was sunk in the unused plant, and there was an additional charge annually upon the company's affairs for the interest on that money without any return. This was the explanation of why they wanted money. He would put it to the meeting, and ask them to keep to that point. Was there any possibility from any source of getting the £50,000 that they needed, and was there any gentleman present who thought that if they got it they could work the business in France so as to produce practical and valuable results? If not, the other two courses were apparent; they might drift on as they were doing at the present time, drift on with a proved loss of £18,000 during the seven months of last year, and a continuing loss, the amount of which they did not know, now going on for the present year; but they might go on with more than that, they might drift on with creditors pressing them and the directors doubtless doing the best they could under the circumstances, but doing, he thought, very foolishly; the directors met the pressure by renewing bills at ruinous and extortionate interest. The facts could be proved, but practically it amounted to this, that some gentlemen wanted £8,000 of this company, no doubt wanted it honestly; he knew nothing about the circumstances; they could not be paid, and the directors appeared to have given them bills for £10,000 instead of £8,000. If the bills had run for a year that would have been 25 per cent.

Mr. F. L. RAWSON: That is not the case. It is not quite correct.

The CHAIRMAN (continuing) asked how far it was wrong. He was not going to bind himself to a precise figure, but he would state definitely upon examination, that Mr. Burnside was satisfied that those bills had been renewed at a very enormous rate of interest; that was the practical point, every such additional charge to a creditor diminished to that extent the chance of the debenture holders and ordinary shareholders getting anything at all, and if that sort of thing went on, they might find the preferential claims, as creditors, so great that they practically took all the available resources of the company; that was the argument to be taken against any policy that had existed with the directors for the last few months. If they could not raise the money and carry on, if they did not want preferential claims, the other alternative was a very unpleasant and disagreeable one, but it had to be met in this life, and must be met by the shareholders taking hold of the thing and saying, this thing must stop, we must liquidate, and, so as to prevent anybody taking a preference claim, they must liquidate in the wisest and best manner they could, not leaving the liquidation to those who reaped the profits of the thing, but putting it in the hands of those who had suffered the loss, and in that way make the best attempt they could, to make the best of a bad business. He had unfolded the facts to them, he had spoken with the utmost frankness to the meeting, his interest in the matter was not large and yet he had paid for his shares, and did not want to lose all the money if he could help it. There was no more to be said, but he was satisfied with two things, he would not personally consent for giving more money to enable the present management to go on further contracting debts, secondly he would not consent to allow them to drift so that they could create more preferential claims. That being the case he would be willing to agree personally to put a hand to the thing and try to get as much as they could out of the fire (loud applause).

Major JONES (the present chairman of the Company) said he came there prepared to put before them, as he thought it was due to them, the manner in which the money that had been spent had been dealt with. He, however, found this unnecessary, because Mr. Burnside, in his report, which they had not seen until they came into the room, put practically the same figures before them as he would have done himself. The only matter that he would point out was this, that out of the total money which they had received, the price that appeared in the balance sheet paid for patents was £150,000 and £33,875, making £183,000 in all, in shares and cash. The next point was that of Mr. Foster's report. They considered that, on the main points, those which were really important for the present and the future of the Company, Mr. Foster's report was very satisfactory. He confirmed all the directors' estimates, he stated that their manufactures were excellent, quality superior to ordinary drawn brass tubes, and they commanded ready prices. He said the heads of the departments were thoroughly competent, but he was not satisfied with certain points. As the circular-letter of the committee told them, and Mr. Foster's report also, the directors thought that Mr. Foster had

acquired an exaggerated idea of the amount of money expended in alterations to the plant; the alterations had consisted in the driving gear principally. Out of 264 tanks 140 had already been altered as was necessary, and M. Künst—M. Secretan's right hand man—said that the cost of altering the remainder would certainly not exceed £3,000. He could not, unfortunately, give them a detailed cost of the alterations, they had asked for it, but M. Secretan said he could not send it at once, but would get it up and let them have it. As regarded the question of the state of the Elmore process, referred to by Mr. Foster, when they purchased it there was no question about it that the Elmore process was in operation on a very considerable scale at Leeds, and they were making large diameter tubes of excellent quality. They had reports of experts which bore that out. M. Secretan decided, they must remember, that in order to meet the regular current demand for tubes in France, that it would be best to commence with a small size, which they were not manufacturing at Leeds, and which required a certain amount of experimental work to work out, and that, of course, formed a part of the preliminary expenditure which was made before they were in a position to commence the regular manufacture. With regard to the expenditure on the buildings and plant, they knew, as a matter of fact, that those buildings were cheap, the contractors lost money on them; they were built very largely of stone, which was cheaper than brick in the locality. He next came to the question of the future; first, as regards their liabilities, there was no question if they had, at the present moment, to meet those liabilities, it would be impossible to do so; but, as they showed in their (the directors') circular, the £92,355 of liabilities included, first of all, over £39,000, which had been advanced by the Foreign and Colonial Elmore Company, and was secured on a second mortgage, and for that there was no pressure of payment. In addition there was about £9,834 owing to friends and large shareholders and others—directors included—and that, they had no doubt, could be satisfied by the issue of preference shares. There was £2,500 owing to sundry creditors, who had agreed to take preference shares. There were £29,485 deferred claims, not due until the end of this year or the beginning of next. £3,231 was debenture interest, directors' fees £784, and sundry creditors, practically the whole of which they could satisfy with shares. £2,523, certainly, must be paid in cash in London, and payments in France amounted to £7,530, also to be paid in cash, so that, with a little over £10,000 they could pay off those present cash liabilities. They might, of course, have to pay a little more, but he thought the greater part would be taken in shares. Mr. Foster's calculations of the profits were on an output of 100 tons per month, which was about one-third of what the works were capable of turning out, if they were able to carry on the output, M. Secretan stated he could arrive at it in three or four weeks if they gave him the necessary money—(loud laughter)—without copper he could not manufacture. If they were able to place the remainder of the new debentures, the interest payable on them would be £7,000 a year, the interest on the second mortgage was £9,400, and if they took £15,000 for depreciation, and other expenses referred to by Mr. Foster, there would be a large profit on an output of 100 tons per month sufficient to pay interest on the preference shares. That was ten per cent. interest. They ought to have £25,000 to meet liabilities in France, and for working capital. If they had the money they could re-establish such confidence in the Elmore process that they would be able to get some money on reasonable terms. Liquidation, he said, at the present moment simply meant ruination or total loss to the ordinary shareholders, the charge of mortgage on the property in France held by the Foreign and Colonial Company, had first charge over any of the debts, and naturally they would look after themselves. What he would put before them was this, that if the shareholders found that money—that £30,000 to enable them to work and show a profit—the Company would be in a much better position than if reconstruction were considered, and the shareholders would get something out of it.

Mr. GLADSTONE: What would the present directors put down towards that sum?

Major JONES continuing, said: The original Board was now reduced to three; Sir Richard Reed had given up, Mr. Phillips resigned, and Mr. Holmes resigned, and Mr. Elmore also resigned because of so much work in connection with other companies. That left himself, Sir James Mackenzie and Mr. Carson, and if the meeting decided to go on they would be very glad indeed to have the Board strengthened by some business men. After some remarks from Major Jones regarding directors' fees, Mr. Gladstone and Mr. Storey repeated the question as to what the present directors would contribute to the sum required.

Major JONES said he could only say he was a very poor man, and he could very ill afford to lose what he would lose over this Elmore Company, which amounted practically to over £3,000. He was in that position that he could find very little more money to pay in, but if the shareholders decided to take up preference issue, he was prepared to put in his proportion.

Mr. F. L. RAWSON said he would like to correct for the reporters a statement of Major Jones's. He made the interest on second mortgage £9,400 instead of £2,400. There was also an accidental mis-statement in the original circular of the committee, namely, that he (the speaker) was connected with the management of the company, as he had never been connected with the management of the company, with the exception of giving advice with regard to the method of dealing with M. Secretan, and with regard to one or two technical points he had had nothing to do. When the company had been in difficulties he had helped them to enable them to go on. He then entered lengthily into the history of the company. He quite agreed with Mr. Storey that the company required new management. If they wound-up it meant absolute loss to ordinary shareholders. He said a few words in praise of Major Jones, who, he thought, "had really worked like a 'brick.'"

The CHAIRMAN here called Mr. Rawson's attention to the fact that little of what he was saying was of interest at the moment. It was an old story. They were busy men, and did not wish to waste time.

Mr. RAWSON said he would merely add this, he would ask whether Mr. Storey or some others of the committee would go on the Board?

Mr. STOREY (very emphatically): If you give me a million per annum I will not.

Mr. BOGLE said the chairman of the company had referred to the remarkable success of the process in England; he would, however, point out that the great success was evident by the fact that the shares had almost disappeared from the share list.

Mr. STRETTELL, a shareholder who caused the meeting much amusement, called Mr. Storey a "thorough pessimist." His circular was misleading. He was proceeding to put questions to the meeting such as "Do you believe that if you get copper to put into those tanks they can turn out 100 tons per month?" (No!) "Do you then believe there are any works at Dives at all?" when

A GENTLEMAN rose to a point of order and suggested that Mr. Strettell was wasting their time. Mr. STOREY said he thought this gentleman was right, and he asked Mr. Strettell to come to the point.

Mr. LE NEVE FOSTER made some remarks with regard to his report. He said that Major Jones and Mr. Rawson seemed to have misunderstood it, because his report as regarded the estimate of the cost of making copper was not an estimate of what they "are doing at present," but it was an estimate in his opinion of what copper could be made for if proper works and proper expenditure were incurred. With regard to the works at the moment being able to turn out 14 tons a week, his own opinion was that they could not do it commercially, and they could certainly not turn out 60 a month or 100 a month at a profit. Major Jones had remarked with respect to the value of the works at Dives; his own remark referred not only to the works but to the plant and the expenditure that had been made at Dives, and he must say that he certainly thought that a very large sum of money had been spent there, and before the works could be worked at a profit a very large sum further would have to be spent. Most of his remarks in the report were not so much with respect to mechanical plant there as to those connected with the Elmore process; perhaps it was a large thing to say, but it seemed to him that the whole work at Dives had been nothing more than a huge experiment. That was his opinion, he should like it to be understood because from the remarks of Major Jones and Mr. Rawson it seemed they were rather misled with regard to his calculations. That estimate did not include general expenses, which were a very large item. It was simply a question of wages and material. It did not include the interest on capital, it did not include management expenses. He had a list of the orders that had been received since the 14th January till the time he went there, and the figures were certainly small considering what they thought had been done there.

Mr. STRETTLE was up again here, and said: I should like to ask Mr. Foster if money is found and works put into proper order, whether we shall get a return of our money?

Mr. FOSTER, replying, said: I think the large amount of money expended on it will kill anything you have got.

Dr. HEDLEY made some remarks regarding the various prospectuses of the Company. He thought the directors or secretary must have issued them in ignorance or with a purpose to deceive the public.

Mr. WILLIAM SAUNDERS, M.P. (a member of the committee) said he was in hopes they would have had over from the directors or Mr. Rawson some practical proposals. Unfortunately, nothing had been put before them except the old cry, "want of capital, and without that we cannot buy a ton of copper." It was a curious statement after £406,000 had been expended, a sum very much beyond the amount which was originally spoken of as being required. What did the accounts show? They showed that at the end of the year the value of copper at the works was £15,000, and the value of stores £5,000. Was it, therefore, common sense to suppose that it was the want of copper that had stopped the production when they had in hand in stores and copper £20,000, and were only producing £1,000 a month of manufactured copper. Mr. Rawson should remember that they were not all marines, and really when he put a statement before them it should be something a little more probable than that. Here they had a process under their command which they were told would add something like 30 per cent. to the value of copper in less than a fortnight. Was the Company in such a position now that under those conditions they could not even obtain copper to produce that result. He ventured to say that that statement that they were short of copper was the strongest condemnation on the management of the Company that could possibly be made. Mr. Rawson repudiated any responsibility for the management. He (the speaker) was surprised to hear him say that, because he must confess that from what he saw and the communications he had had from him, and they had been very numerous, he came to the conclusion he was the mainspring of the whole thing, and he thought it would have been more honourable had he stayed by his colleagues than get out of it at this moment. [Loud applause.] They wanted to deal with the matter as a matter of business, but what was it as a matter of business? It was perfectly clear that there had been very gross misrepresentation or gross mismanagement; there must have been one or other, or both—certainly there was one or the other, and his impression was distinctly that Mr. Rawson was responsible both for the representation and the management, and that was a matter which he thought wanted very thoroughly inquiring into. What was it they wanted to do? They wanted to stop the loss which was now going on. The speaker quoted dates and figures to show that

33 per cent. was being paid on renewed bills, and he held that they must at once take steps which would stop the loss which was being made of £100 per day, and also stop the payment of such interest as 33 per cent. on bills. He hoped they would resolve for a voluntary winding-up under the supervision of the Court, and he would willingly move that.

There was considerable further discussion regarding winding-up, in which Messrs. Maddison, Storey, Saunders, Dickinson, Gladstone, F. Rawson and Harman took part.

Mr. GLADSTONE moved the following:—"We, the undersigned shareholders in the Elmore's French Patent Copper Depositing Company, Ltd., hereby signify our desire that the Company should be voluntarily wound-up, with a view to reconstruction under the supervision of the Court, on the following grounds:

"That the Company cannot by reason of its liabilities, carry on its business, and that the Company is unable to pay its debts, and that Messrs. Harries, Wilkinson & Raikes, solicitors, be instructed to institute the necessary steps for winding-up accordingly, and that we will attend the necessary meetings with a view to obtaining the necessary resolution; and that the directors be called upon to call a meeting for this purpose on 5th day of April next."

This was seconded.

Mr. F. L. RAWSON moved an amendment:—"That a committee be appointed here with full power, to take such steps as they think fit to protect the interests of the shareholders."

This was also seconded.

The amendment was put to the meeting and lost.

Mr. GLADSTONE's original motion was next carried, without any dissentients.

Major JONES consented to call the meeting for the date mentioned.

A vote of thanks to Mr. Storey and the other members of the committee terminated the proceedings, which had lasted two and a half hours.

Elmore's Patent Copper Company.

AN extraordinary general meeting of Elmore's Patent Copper Depositing Company, Limited, was held on Thursday, last week, at the Cannon Street Hotel, under the presidency of Mr. J. J. Atkinson, "to consider the steps to be taken with a view to raising additional working capital for the purposes of the company."

Before the proceedings commenced, the Chairman took the sense of the meeting as to whether the proceedings should be conducted in private or public, and the shareholders almost unanimously voted in favour of the meeting being public.

The CHAIRMAN said the Elmore process was perfectly successful as a manufacturing operation, and their confidence in this respect, notwithstanding the many difficulties they had had to encounter, had never been shaken, and was to-day based upon an extended experience, and, if possible, was firmer than ever. In further corroboration of this they could point to the French Elmore Company's undoubted industrial success, whose works were laid out on a much larger scale than their own, and they were informed that the expert who recently visited the French works on behalf of an influential body of their shareholders had reported to his principals most favourably in regard to the industrial position and prospects of that company. He begged, therefore, that, notwithstanding the great amount of distrust which was abroad concerning the Elmore companies, they would accept it as the unanimous declaration of their directors that the Elmore process was perfectly sound, and could be worked remuneratively. (A VOICE: "To the directors," and laughter.) The capacity of their works at the present time was for an output of from 15 to 20 tons per week, and they had a considerable number of orders in hand in course of execution. They would have no difficulty whatever in obtaining orders for steam pipes sufficient to occupy the whole of their plant and take up the whole of their capacity of 15 to 20 tons a week. Their one and only barrier to taking these orders and earning a dividend for the shareholders was the fact that they lacked an adequate supply of raw copper, or, in other words, they lacked the necessary working capital for carrying on the business. They had experienced this want of copper for many months past, and this alone would account for the smallness of their output. The following figures were taken from their actual working books at Leeds. The finished output from June 30th, 1892, which was the date of their last balance-sheet, up to February 25th last was 102 tons, an average of three tons a week. The actual manufacturing expenses of this output, and, of course, for the same period—excluding only administration charges and interest, and the administration charges were not high, there being but very few paid officials—the manufacturing expenses, then, exclusive of the administration charges and interest, in respect of these 102 tons, was £3,396 12s. 8d., which was an average cost of 3·57d. per lb. They had sold since June 30th up to February 25th last 50 tons of stuff, of which 38 tons were tubes and ram work and 12 tons scrap copper. For their present purpose they might leave out of account the 12 tons of scrap which was sold only at a small profit, and look at the price taken for the 38 tons of tubes. The net invoice value to their customers for these 38 tons was 11·7d. per lb. He had told them that the cost of manfacturing these tubes was 3·5d. per lb., to which they must add 5d. per lb. for the raw copper. The gross cost would thus be 8·5d. per lb., to produce tubes and cover hydraulic rams, and covering charges of every description, except adminstration and interest, even when only turning out the insignificant quantity of three tons a week, which was a mere nothing. Of course, if they were turning out 15 to 20 tons a week, the cost would sink to under 1d. per lb., exclusive of the value of the gold and silver. The French company had already gathered over £1,000 sterling from the bottom of their tanks in the form of silver and gold, even after only a few months' working. Taking 11·7d. as the average price of their sales for the period in question, and deducting the cost price, 8·5d. per lb., they would see that they had a clear profit of 3·2d. per lb. The trading liabilities of the company were comparatively small, and were more than set off by book debts due to the company, and the value of their raw and manufactured copper in stock. They had hoped to have been able to raise money through their bankers or solicitors, but as the negotiations seemed to drag somewhat, they thought it their duty to meet the shareholders at once. Mr. Hooley, one of the directors, had already taken from the company 10,800 shares, of which 2,000 were at 10s. premium, and the balance at par. There still remained in hand 8,800 unissued shares, and the board considered that no better plan could be adopted than the issue of these 8,800 shares as six per cent. preference shares. They were inclined to think that the interests of the company would be served by the appointment of a strong representative committee to co-operate with the board, and who should be empowered to satisfy themselves in regard to the company's position, and to formulate and recommend to the shareholders such measures as might be deemed expedient. So far as they could speak, after careful consideration, they believed that the £17,200 proposed to be raised in preference shares would give them all the money this company would ever require, and would enable them to make a great success of the business.

Mr. FREEMAN made a few remarks, in the course of which he reminded the chairman that all the promises made in the past about the great success of the company had not been fulfilled.

Mr. W. ELMORE, in reply, said he was quite prepared to show that there was not a single statement which could not be thoroughly substantiated. With regard to the pan license, a contract was entered into with a gentleman at Nottingham, and that contract was in existence at the present time. By the contract the company were to get £50,000 in cash for the application of their process to the manufacture of pans for the Midland Counties alone. In consequence of certain circumstances which happened, particularly the sudden drop in the price of their shares, the parties who took the pan licenses were obliged to ask for delay. That request was granted, and the matter still remained in abeyance. The Pan License Company would, however, come into existence as soon as things improved a little, and they would receive their money. The statement that he and his sons had sold their shares in the company was entirely unfounded. As a matter of fact, they were larger holders of shares to-day than they had ever been before. They only wanted copper in order to make the business a success and to realise the large profits they all anticipated. As managing director he had never charged the company a single penny, and he did not intend to do so until they were able to pay good dividends.

In the course of further discussion the CHAIRMAN said he had £40,000 in the different companies, and it was not his intention to desert a sinking ship.

Mr. INVERARITY suggested that the directors should furnish the shareholders with a statement showing the amount of capital originally subscribed, the amount since obtained on mortgage, and the manner in which the money had been expended.

The SOLICITOR (Mr. Hays) said a great many mistakes had been made in connection with the company, the first being the payment of a dividend of 50 per cent. That money ought to have been kept for the purpose of buying copper. He did not believe the shareholders would subscribe the money required unless the Board were supported by a committee of independent shareholders, who should thoroughly investigate into the past, present, and future. He therefore proposed the appointment of a committee of seven shareholders (three to form a quorum) to investigate and report to a further meeting of shareholders in London, to be called so soon as the committee shall have settled their report.

Mr. J. TODHUNTER seconded the resolution, which was carried unanimously.

The following gentlemen were appointed to form the committee:—Messrs. J. Todhunter, Inverarity, Gore, Squire, Pritchard, Webster and Davidson.

Elmore's Wire Company.

AN extraordinary general meeting of Elmore's Wire Manufacturing Company, Limited, was held immediately after the Elmore Copper meeting, Mr. Atkinson again presiding.

The CHAIRMAN said the directors were not asking the shareholders to bolster up a defeated process, but simply to take advantage of a complete success which they had now achieved as an industrial operation. As the shareholders were informed in the debenture prospectus recently issued, the company owed an amount of £11,000 and interest to its bankers, and there were sundry creditors amounting to about £9,000 in all. In reference to the recent proposed issue of £50,000 of first mortgage debenture stock, the subscriptions up to the present time had only reached between £8,000 and £9,000, and even these were conditional upon a total amount of not less than £25,000 being subscribed. As their managers did not think this sufficient to successfully work the business, Mr. W. Elmore had been instructed to open negotiations with certain parties for the purpose of ascertaining whether a loan could be raised from one of the financial corporations of the City. He had since been in communication with a substantial corporation, and also with a representative of a firm of bankers having a branch at Leeds, with the result that from one house or the other they could secure £20,000 by giving a first charge upon their property, provided the shareholders would subscribe a further £20,000, to be secured by a mortgage debenture, ranking immediately after the first £20,000 just mentioned, but which would still be within the first £50,000 originally proposed to be issued. The Board considered it advisable that the shareholders should appoint a strong representative committee with a view to verifying the statements of the Board, and to formulate such measures as might be deemed expedient for

promoting the interests of the company in every respect. It would be necessary also in the opinion of the Board that a guarantee fund should be established for the purpose of paying off the pressing creditors, and so bridge over the time necessary for the issue and subscription of the debenture stock. This was a matter which would come within the purview of the committee.

On the motion of Mr. Hays, Messrs. Todhunter, Gore, Pritchard, Webster and Davidson were appointed a committee of investigation.

Mr. F. L. Rawson, replying to Mr. Jones, said he was asked by the Board if he could do anything to place the shares.

A Shareholder: It appears to me you have always been doing something for the company.

Mr. Rawson (continuing) said the only people he could get to take them were the Phœnix Trust.

Mr. Dale expressed the opinion that the present downfall was due to reckless management.

Mr. Hays stated that it would be necessary to have £3,000 to pay off the pressing creditors, pending the report of the committee.

A canvass of the meeting resulted in many of the shareholders guaranteeing their proportion to the fund proposed to be raised.

Woodhouse and Rawson United, Limited.

An extraordinary general meeting of this company was held at Cannon Street Hotel, on Monday last, 20th inst., Mr. Samuel Pope, Q.C., presiding.

The Chairman said he had received a note from Sir Rawson Rawson (the chairman of the board), which he read to them. The letter was dated Saturday, from 68, Cornwall Gardens, and stated that the distressing family bereavement which had within the last few days befallen him, still weighed so heavily upon his mind, that he felt unequal to taking the chair at the meeting. He said he would be very sorry if his absence should have the appearance of his avoiding his full share in the responsibility. He begged Mr. Pope to explain to the shareholders the cause of his absence, and make his apology to them.

Mr. Pope said that no doubt the shareholders were aware that Sir Rawson Rawson had lost a very dear daughter, and that had at his age, and in his state of health, had a very considerable effect upon him. In his absence he had been requested, with the shareholders' consent, to occupy the chair at the meeting.

The notice was then read convening the meeting.

The Chairman then said: Gentlemen, I think my duty in the chair will be best performed by putting you as exactly as I can in possession of the facts as regards the present position of the company. Since we met together to receive the report of the committee which was appointed at the annual general meeting, a receiver has, at the instance of a debenture and shareholder and a creditor, been put into possession of the assets of the company as receiver and manager. The directors did not see their way to resist that appointment, nor did the trustees for the debenture holders; in fact, Sir Rawson Rawson and myself, as representing the debenture and stock holders, felt it was necessary, if a receiver was appointed at all, he should represent the whole interest of the company, and not one particular class of interest exclusively; and therefore the receiver and manager is now in possession of the assets of the company representing the debenture holders, the debenture stock holders, and also the interests of the shareholders. He has been, by the authority of the Court, as I understand, enabled to raise a small sum of money for the purpose of carrying on the business of the company to a small extent, in order that it might not subside altogether. In addition to the receiver now in possession with the sanction of the Court, there are upon the file of the Court two further petitions—petitions, as I understand, praying for the appointment of a liquidator under a compulsory winding up; and therefore, as those petitions stand over, and will not be heard until April 11th, the directors have thought it important that the shareholders should meet to discuss the position, in order that they may decide whether, in the interests of all parties, it is desirable that the concern should be broken up, or that an effort should be made to keep it together, in the hopes that something may be done to minimise the loss to all concerned. I do not desire to make any comments, now, upon those petitions, but I must venture to say this, that it appears to me that eagerness to break up the concern is proportionate to the smallness of the stake which the individual petitioner possesses in it. The first is on the part of a debenture stock holder for the small sum of £250, and it did appear to the directors—certainly to me—to be very desirable that those who have a larger stake in the concern than that should have an opportunity of deciding what is the best way of dealing with it, instead of leaving it to be dealt with by somebody who, after all, has only a very limited interest in the matter at all. I do not know who the second petition is from. The question is really one for the shareholders—for, after all, it is the shareholders' interest which is most involved in the question; for you will remember that the report of the committee—about which I do not mean to say a word now in the way of discussion—pointed out that if the assets of the company were realised in an intelligent manner, there would probably be sufficient to pay the liabilities of the company. I own I——

A Shareholder: How about the shareholders?

The Chairman continuing: If you forgive me for a moment, I can only deal with one thing at a time. If you will be kind enough to give me credit for intending to deal full fairly and honestly with the whole matter, we can get along much better than by interruptions which are a little hasty. The report of the committee pointed out that the debenture holders—I do not say were safe—but there was a fair chance that they would be paid off. Further, you see the interest of a debenture holder in winding up is not like the interest of a shareholder, who, if the concern is broken up altogether, and the assets realised at broken price, has not much chance to get anything back, I am afraid. The question really is a question for the shareholders to determine, whether something should be done, by reconstruction, or in some other way, to endeavour to save some of the assets of the company for the benefit of the shareholders. That is really, as it seems to me, the question which you have to decide. You will have observed that we have called you together, with the formalities which are necessary, to make your resolution a binding one on the company, and not a mere gathering together of those who cannot pass any resolution, but something which may be effective in its way. As far as the directors are concerned, and as far as I am concerned, if the shareholders see their way under new management to reconstruct the company, we will do all we can to facilitate and assist in such reconstruction. Speaking for myself, I think it is essential that, in any reconstruction, those who find the sinews for the purpose of that reconstruction should have the nomination of those who are to have the administration of the affairs of the company. I think I speak the unanimous feeling of all my colleagues, that in the event of the shareholders desiring such reconstruction, our seats at the existing board will of course be placed at their disposal, and they will be asked to find a new board of directors for its administration. But we are also very strongly of opinion that no scheme of reconstruction could be likely to be acceptable to the shareholders, excepting upon three conditions. It seems to us exactly as it appeared to the committee who met us on the last occasion, that it would be idle to expect shareholders or anybody else to put more money into the concern if the profits of the concern were to be swallowed up in the payment of old liabilities, or in bearing the burden which the debenture debt casts upon it. We therefore think that if any scheme of reconstruction is to be practicable, the first thing to ascertain is, that there is a good background of business worth preserving. As far as I know, the facts with regard to that are these—you may satisfy yourselves as you desire it other than by my mouth, I can only take it from those who know something about it. You will remember that the report of the committee estimated, without being able to go into any amount of detail, that the industrial part of the business might command about £11,000 a year profit, that £11,000 a year being only about enough to pay the debenture interest, and therefore leaving nothing to be divided among the shareholders of the company. The general manager of the company takes a more sanguine view than that, judging from the business which he has been compelled to refuse since our general meeting in December, he puts the profits at very nearly three times that amount; but I may also say this—I, of course, am only telling you that is his sanguine expectation—but the receiver, I believe, has formed his judgment of the possibilities of the business from the experience that he has had. In the meantime, I am told that if asked he will express his opinion, though I have not the information as to what that opinion is, really. It does seem to the directors perfectly plain that whether the income be £11,000 or £30,000, or anything between the two, the first people who ought to have a claim upon those profits are those who find the money for carrying on the business. The second condition appears to me that the money found should not go to the payment of the old debts, but that the old debts and charges of the company should be left chargeable upon the assets of the company as they are now, without change of rules or without additional charge; and, further, I am myself bitterly sensible that in any reconstruction the shareholders ought to require entirely new management of the industrial part of the concern. Well, now, then on some such lines as that, the question is whether you, as shareholders, think it would be better to break up the concern—which, of course, means the immediate realisation of assets, which require time to develop them, and to be realised at their full value—or that an attempt should be made in order to see whether a reconstruction of the company may save something in the interests of the shareholders, who otherwise I am afraid will get nothing. If that is your view, then the resolution which is in the circular convening the meeting will be the resolution which you will pass. In order, if you wish it, that you may know more of what has been done by the directors in the way of endeavouring to bring about such a scheme of reconstruction, I will ask Mr. Carslake, who represents the company as solicitor, to give you a sketch of such a scheme. Of course you are not bound to that; the resolution would be appointment of a liquidator to conduct a voluntary winding up, with a view—not to realise the assets instantly—but with a view to realise them, if possible, gradually, and at such prices as would leave something out of the wreck. The best course would be for me, before I sit down, to move the resolution. The shareholders will discuss it; I will ask Mr. Carslake to explain the general character of the scheme which has been before the meetings of the board, and then you may discuss and say what ought to be done in the matter. He then moved:—"That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that there be conferred on the liquidator or liquidators all the powers which, by virtue of the Companies' Acts, 1862 to 1890, can be conferred on liquidators."

Sir John Stokes seconded the resolution.

Mr. Carslake said: Mr. Chairman and gentlemen,—I do not know that I have very much to add to what Mr. Pope has already said with regard to the scheme for reconstruction of the company; it is as yet only in outline, and the details of the particulars will require further consideration. Broadly speaking, the suggested scheme is as follows:—That a new company should be formed which will take over the assets of the existing company, but will take them over in such a way, that whilst the charges of the debenture holders and debenture stock holders on those assets will remain fixed there, the

new company will not incur any personal liability to the debenture holders or debenture stock holders. The new company will take those assets and use them, and realise them, paying the proceeds to the receiver or liquidator of the existing company, who would distribute them amongst the debenture holders and debenture stock holders, and the new company will get a certain profit on turning over the assets and realising them. Then, by that means, the existing company will have whatever working capital is put into it, intact and unfettered, by the existing company in any way. The ordinary creditors of the existing company would, of course, have to be dealt with in some way, and met in some way, and the proposal is that they should be offered preference shares in the new company, and if they do not accept those preference shares, that they should retain their present position. With regard to the bringing in of capital for the new company, and dealing with the shareholders of the existing company, there are two schemes, with regard to which the directors have not yet quite decided which is the best one. That the working capital should be found by the issue of shares, which will be paid for in full by the shareholders, and that the shareholders should receive some sort of security—income bonds or something of that nature, which whilst imposing no further liability on them, will give them a right to the surplus profits of the new company, or that something in the nature of income bonds, with, say, 90 per cent. credited as paid up, and the remaining 10 per cent., to be called up for the working capital, should be given to the shareholders of the existing company, who may then possibly be given a small nominal share in the new company, carrying with it voting power, so that they will retain their control in the new company. The shares or income bonds, whatever they may be, would have to be offered, first, to the preference shareholders in the existing company, and those that are not taken by the preference shareholders will be offered to the ordinary shareholders to be taken up by them. This is necessary, because the preference shareholders have a first claim on the assets of the existing company, both as to capital and dividends. I do not think at the moment I can go into further details, because the scheme is now before counsel for consideration, and it is one which, of course, requires the very greatest thought and care to work out a thoroughly good scheme, and the time which has been at disposal for the purpose has hitherto been rather short.

Mr. SWAIN argued that the report of the committee showed that there was no possibility of a dividend being made, or of anyone but a debenture-holder getting a penny.

The CHAIRMAN: You are entitled to say that, though your interest is not a very large one.

Mr. SWAIN said he represented a large number of shareholders. He contended that they would be letting the directors out of their liability by forming another company.

The CHAIRMAN said that was an absolute delusion. Nothing they did in the manner suggested would relieve the directors of any responsibility that might attach to them.

Dr. DUNCAN said he took 100 preference and 200 ordinary shares on the faith of the prospectus that was sent round in November, 1891, which stated that the balance-sheet showed a profit of £35,000 odd, which, with the sum of £16,000 from the previous year, made a total of £51,000. The report of the committee showed that no such profit ever existed. He wished to know on whose advice the directors acted in taking the profits in respect of the Kensington Stores.

Mr. CARSLAKE said the counsel was Mr. Kenyon Parker. There was no case stated, because the opinion was taken in conference.

Dr. DUNCAN said it was manifest that the statements put forward in November, 1891, were, some of them, absolutely false. At a time when they were borrowing money at 10 per cent. to 22 per cent., in order to pay glowing dividends of 15 per cent. on the ordinary and 8 per cent. on the preference shares, the directors had the audacity to ask the public to subscribe for ordinary shares at a premium of 5s. per share. He considered he had been defrauded of over £1,500, and he should not submit to it in silence. He appealed to the shareholders not to agree to voluntary liquidation, but to have a judicial winding up, so that the transactions of the company might be investigated officially, and also the conduct of the directors thoroughly investigated in the Bankruptcy Court. He saw no other way for them to guard themselves than to do that, not only should they do this for themselves, but they owed it to the public not to allow such companies to be promoted. In addition to these proceedings, he would ask all those shareholders who took shares on the new prospectus in November, 1891, to support him in his determination to bring action against the directors for the false statement contained in that prospectus. The only other remark he would make was to formally propose that the company, which was rotten to the core, be judicially and compulsorily wound up, and the whole matter investigated in a proper manner.

Mr. W. S. SQUIRE (Chairman of the late Committee of Investigation), said: The printed paper sent out with the notice convening the meeting is not a full report of the proceedings of the meeting when the committee's report was read. Although my opening remarks are given, Mr. Pope's speech, in which he admitted the substantial accuracy of the statement of facts in the report, is suppressed. Instead of this, the directors have published the report of the committee and their own observations on it in parallel columns. The report was couched in most moderate terms, and might have been made much stronger; but the committee wished to let down the directors as easily as possible, and I think those gentlemen would have been better advised if they had accepted that report frankly instead of attempting to minimise it and explain it away. The committee is now dissolved; but, as the late chairman of that committee. I cannot allow these observations to pass without comment. In order not to make the report too long many matters were omitted, or glanced at only in general terms. The directors compel me to go a little further. I stated that the directors suggested we had no power to go into the past. This is denied. The fact is that the committee were meeting in one room while the board were meeting in another. At the wish of the directors the committee went into the board-room, and Mr. Pope, as spokesman, argued at great length that we were a consultative committee, to advise the board as to the present and future, but without power to go into the past. Mr. Pope himself will, I think, confirm this. When the committee decided to go into the past no difficulties were thrown in their way. The directors deny that the profits of the first year were made up of "very doubtful items." The committee have given their reasons for thinking some of them doubtful; the directors now supply another. The Kensington and Okonite items must have been very doubtful if the directors thought it necessary to consult counsel as to whether it would be safe to include them or not. Counsel can only advise on the case presented to them. It is not their business to hunt up the facts; and counsel's opinion will depend much on the way in which the case is presented. The directors deny that the managing director received any part of his commission in cash. The facts are these: In June, 1890, the managing director owed the company £3,607 9s. 7d.; on June 30th, 1890, he was credited with £13,775, which then made a balance in his favour of £10,167 10s. 5d. Between that date and September 13th, 1890, he received from the company in cash £34,600, while his account was not credited with anything till December 31st, 1890, when he appears to have paid the company £189, which is the only thing to his credit for that half-year; so that he not only received the £10,167 10s. 5d. in cash, but a great deal more besides. What he did with the money subsequently—whether he invested it in this or any other company, or spent it in cigars—has nothing to do with the question of the accuracy of the committee's statement. It is said that the agreement to cancel the managing director's debt by taking debenture stock at its par value was really entered into before that stock was depreciated. This explanation was suggested to the committee. They, therefore, searched the minute-book to find some record of the transaction, but in vain. The directors must therefore, by their own showing, have entered into an agreement involving about £20,000 without making any entry of it in the minute-book. Moreover, it is not easy to see why the transaction was not completed at the time the agreement is alleged to have been entered into. The committee have pointed out that the Epstein profit was a purely fancy figure. The Epstein Company existed only on paper. The capital was £100,000 on paper, the allotment was £70,000 on paper, and the profit of Woodhouse and Rawson United, Limited, was £31,630 on paper. The capital might just as well have been called £200,000, and the allotment £140,000, in which case the profit would have been £63,260, every bit as substantial as that actually claimed. On looking back, the directors must be astounded at their own moderation. It is probable that counsel's opinion was not asked about this. The directors complain of the valuation of the securities, and instance the Okonite debentures, which happen to be about the only securities in the list to which anything approaching to a definite value can be assigned. These, the directors say, are worth £24,000. If that be so, why did not the directors sell them, instead of mortgaging them to the Northern Assets Company as security for a loan of £18,000 at 15 per cent? If these were good security for even £18,000, the interest would not be 15 per cent. The committee did not overlook the income of £1,400 a year from these debentures, but they also looked at the fact that the interest on the loan was £2,700 a year—an outgoing which exceeded the income by £1,300. As for the Phœnix Company, this appears to have been a parasite on Woodhouse and Rawson United, Limited, grown for a special purpose. It came into existence soon after Woodhouse and Rawson United, Limited, was formed, and was wound up as soon as Woodhouse and Rawson United, Limited, got into difficulties. It is suggested that the Phœnix Trust Company was employed by Woodhouse and Rawson United, Limited, to underwrite the companies promoted by the latter. Imagine a company with a capital of £200,000 or £300,000 applying to a company with a capital of £1,124 to underwrite its promotion. The thing is absurd on the face of it. If Woodhouse and Rawson United, Limited could float companies, they need not have gone to the Phœnix Company and give them one-half, and sometimes three-quarters, of the profits. If they could not manage this company business, they had better have left it alone. It appears that Woodhouse and Rawson United founders' shares in the Phœnix Trust, which the committee could not find at Somerset House, were registered in the name of North. The 100 founders' shares in this company were held, as to 50 by the National Financial Company (practically a well-known company promoter), as to 25 by Woodhouse and Rawson United, Limited (alias North), and as to 25 by Mr. F. L. Rawson. As far as I can ascertain, the business of this company practically consisted of what Woodhouse and Rawson United, Limited, ought to have done for themselves, but sent to the Phœnix Trust Company to do for them. Of the profits thus realised, one-fourth would come back to Woodhouse and Rawson United, Limited, one-fourth would go to Mr. F. L. Rawson, and one-half to the National Financial Company. As the directors of Woodhouse and Rawson United, Limited, claim that their fourth share of profit was so huge as to justify them in raising the capital value from £25 to £15,000, so also would be the profits of the other partners. It will be evident that the Phœnix Trust Company was not without its *raison d'être*. It is no wonder that it got so much business, and was allowed to have a lion's share of the profits. I understand that when the Phœnix Company was wound up, or, as the directors prefer to put it, divided its assets, Woodhouse and Rawson United, Limited, was brought in a debtor to the Phœnix Company for some £600 or £700. As chairman of the late committee, I adhere positively to the statements in the report about the practical value of the securities and the interest paid for loans, as extracted from the books, however the directors may seek to explain these things away. Other observations by the directors are already dealt with in the report itself. I may make one or two additional remarks; however the directors may quibble about each item

by itself, the solid fact remains that they have induced the shareholders to believe for two years that the company was doing well, and making substantial profits, and at the end of the third year had to confess that they had muddled away the whole of the ordinary and preference capital of the company. There was a thing which I had forgotten to mention; that is, that there was a complaint made of the rate at which we valued the patents. There were several things to be said in connection with those patents. A great deal had been said of the valuable lamp patents of the company. It turned out that as far as the register at the Patent Office went, those patents were not in the name of the company at all. It is said that there is an agreement to transfer them; but as a matter of fact, they have not been assigned. Then there is a further fact about those valuable patents, that was that even the agreement to assign went no further than to assign a half of them to the company. They had only interest in half of those lamp patents, and anybody having to do with patents would tell them that half patent, unless under very special circumstances, was practically no patent at all.

The CHAIRMAN stated that there was a special agreement.

Mr. SQUIRE said then it depends what that is; but all these things influenced the committee very much in calculating the value of those patents, and he justified the committee in putting that price upon them.

Mr. F. L. RAWSON stated that one of the patents had six years to run; there were about four or five different patents of different periods to run.

Mr. SQUIRE continuing: In his opinion, and the opinion of the other members of the committee, the appreciation upon the Phœnix Trust shares, and the production of a large profit on paper in the matter of the Epstein Company patents, looked very much like an excuse for paying dividends out of capital. He did not think it was so, but it certainly bore very much that appearance. Another thing which the committee did not at all like was that £75,000, or a considerable quantity of which was paid to the vendor company in the shape of debenture stock. That debenture stock, at the time it was paid over to the liquidator of the old company, was in a lump, and if that was illegally paid over, he did not express an opinion on, as he was not a lawyer; but even while the committee were at work, that thing was split up and distributed among those persons interested in the vendor company, so that while it might have been recovered at one time, it was no good now. With regard to the proposal for reconstruction, that was a matter upon which it was extremely difficult to offer an opinion at the present time. His own impression was that the way in which a new company could do any good, would be by ruthless concentration, that the Cadby Hall property was certainly far away the gem of the whole. The Manchester place should be shut up and realised, and the Kidsgrove certainly put down as hopeless.

Mr. ABRAHAM said he agreed with what had been said by Dr. Duncan as to the conduct of the directors. He was perfectly certain that if a case had been properly stated to Mr. Kenyon Parker, he would have given a very different opinion to that of which the directors had availed themselves. He believed that liability was still hanging over the directors in regard to their proceedings, and was glad to hear that proceedings were likely to be taken. He thought, however, that Dr. Duncan was mistaken in supposing that, by agreeing to voluntary liquidation, the shareholders' rights, as regarded the directors, would be affected. He expressed himself in favour of voluntary liquidation, as the shareholders would then be able to reconstruct the company, and so, possibly, save something, which they would not be able to do under a compulsory winding up.

Mr. BOND supported the views expressed by Mr. Abraham.

Further remarks were made by Dr. DUNCAN and Mr. BOND.

Mr. MADDISON (in the absence of Mr. Leslie, the Receiver), answering for the receiver, said he had really formed an opinion that there was considerable backbone to the business. He said there was any amount of work to be done. With regard to the work in hand, he said it was being done at remunerative prices, as far as he could judge, and he was surprised to find there was so much good work in hand.

Mr. BACON (one of the late committee) said that they had given to the shareholders their report, and in that report he agreed with everything that had been said by Mr. Squires, their chairman.

Answering Mr. Bacon, the CHAIRMAN said they had no one to propose as liquidator, but that must come before the meeting after the first resolution had been passed.

The discussion was continued by Mr. LAING, Colonel H. POE, Mr. MORRISON, Mr. DOWNMAN, Mr. PILLING, and others.

On the amendment being put to the meeting it was lost, and the motion for voluntary liquidation was carried unanimously.

A long discussion took place as to the appointment of a liquidator. Mr. Pilling (accountant, Manchester) was nominated by Mr. Squires and supported by various members of the committee (of which he was a member) and others.

Mr. WANE proposed Mr. Young (Turquand, Youngs & Co.). He acknowledged the great services rendered by the committee, but thought a well-known independent firm of London accountants should be selected.

On a show of hands there was a decided majority in favour of Mr. Pilling; but a poll was demanded.

The CHAIRMAN, replying to General Fyfe, said proxies would be admissible.

After some time the CHAIRMAN made the following declaration regarding the poll:—(Mr. Squire was appointed scrutineer on behalf of Mr. Pilling, and Sir John Stokes for Mr. Young.)

"I, Samuel Pope, Q.C., chairman of the extraordinary general meeting of Woodhouse and Rawson United, Limited, held at the Cannon Street Hotel on March 20th, 1893, declare that on the poll being taken on the appointment of liquidator, the votes of members personally present and voting in favour of Mr. Young are 5,090, and the votes of members personally present and voting in favour of Mr. Pilling are 6,922. There are also proxies representing 31,476 votes, of which 788 were used in favour of Mr. Pilling and 30,688 in favour of Mr. Young. These proxies have all been objected to on the grounds that some were lodged at the company's offices less than 48 hours before the time fixed for the meeting, and that they were mixed with the rest of the proxies and could not be distinguished. As I have evidence which satisfies me that proxies were received by the company more than 48 hours before the time fixed for the meeting, amounting to 5,139 votes used in favour of Mr. Young, I admit them accordingly, and the like evidence having satisfied me that proxies were received at the office of the company more than 48 hours before time fixed for the meeting amounting to 788 votes used in favour of Mr. Pilling, I admit them likewise, being all the proxies that were lodged in favour of Mr. Pilling. These admitted proxies added to the votes of those present make in favour of Mr. Young 10,229 and in favour of Mr. Pilling 7,710. I therefore declare Mr. Young duly elected voluntary liquidator, recording at the same time that Mr. Squire, scrutineer on behalf of Mr. Pilling, objected to my admitting the before-mentioned proxies in favour of Mr. Young."

W. T. Henley's Telegraph Works Company, Limited.

THE fourteenth ordinary general meeting of the above company was held on Friday last, at Cannon Street Hotel, Mr. Sydney Gedge presiding.

The SECRETARY having read the notice convening the meeting,

The CHAIRMAN said he would not waste much time by making lengthy remarks, but would move: "That the report and accounts in the hands of the shareholders be received and adopted." They would have observed that the notice convening the meeting had not, as used to be the case, been read by Mr. Sutton, as the directors considered that the time had come when that gentleman's valuable services to the company should receive the recognition they deserved by his being elected to a seat on the board. He took up, therefore, the office of managing director on the same terms in all respects as regarded the duties and remuneration, as he had hitherto done, with the single exception that another gentleman took over the secretarial duties, although Mr. Sutton was to remain responsible for them. Referring to the affairs of the company, he said they were like the nation which had no history; they were doing well and prosperously, and there was, therefore, not very much to be said about it. Less than two years ago they borrowed £30,000 on "B" debentures for the purpose of discharging their floating debts, and the arrangement made was that the profits, after payment of 5 per cent. on the ordinary shares, should be applied to the redemption of the debentures. They had now paid off £18,000 out of the £30,000, and if they had paid off £18,000 in two years, he thought there was a very good prospect that the remaining £12,000 could be paid off in another two years. This would be very satisfactory to the shareholders, and then the ordinary shareholders would receive the reward for their patience. They had a good many rivals in the trade, but he was sure there were none who could surpass them in the class of work and the punctuality with which they executed orders. They struck a rather high note by saying that when they had finished their new works the buildings would be worked by electric motors, "and the company will then possess the most perfect workshop of its kind in the world." They were telling no more than the truth. They might be sure the directors thought it over very carefully before putting a statement like that in the report. He (the Chairman) visited the works on Thursday and saw how everything was very well arranged and well built. They had not gone to any outside engineer or architect; their Mr. Hatton had only acted as he had always done, most efficiently and economically, and the money on the works had been well spent. Even if their business were very little increased in consequence of their new works, there would be so great a saving in the way in which they could do their work that there would be a very fair return made on the cost of the works without any new business. They would be able to make cables which they had never made before, by reason of which they had lost orders. He referred to the lead-covered cables. They were now making golf balls, and were effecting very considerable sales, considering the time they had been at it. He recommended the gentlemen present to take to golf playing, and send in their orders to Henley's Company. There was one more remark to make. It was interesting to note that no fault had been reported in any of the submarine cables since 1888; in 1888 they did lay a cable in which there was a fault. If they had been able at that time to give a substantial guarantee that the cables would not get worse, they would have received full payment of the contract money. They were not strong enough to do it, and were therefore mulcted of a certain amount. He was happy to say that the cables had not gone any worse, and were working better than ever. He then formally moved the adoption of the report and balance-sheet.

Mr. R. J. JENKINS, C.E., in seconding the motion, said that with reference to the item of the "B" debentures, that would have a most important bearing—the paying off of those debentures—immediately upon the ordinary shareholders, because the actual saving on the £18,000 was equivalent to 1½ per cent. dividend on the ordinary shares. Gen. Hutchinson and himself, both having a knowledge of engineering, had taken a great deal of care, in concert with Mr. Sutton, to carefully watch all the expenditure made in regard to extensions. The money was being laid out in improving the works, and, as Mr. Gedge had stated, this would not only benefit them in being able to take larger and more important contracts, but would effect a saving in similar work to that they had been already doing. During the past year they had opened a branch establishment at Melbourne, Australia, and

although, as was known to all City men, Australia was at the moment somewhat under a cloud, particularly Melbourne district, yet he was pleased to say that their agent there was able to send them returns of considerable sales which he had made. Of course, it was difficult at first to hit the exact market. Fortunately their managing-director, Mr. Sutton, had sent out goods which appeared to command a ready sale. They were sending out further quantities of their goods on the request of their agent there, and he thought they might look for a *fair* return very shortly, and a *good* return as soon as the cloud was lifted in the Australian markets. They manufactured and laid a long cable successfully between the Bahamas and the coast of Florida (U.S.A.); and while doing that they were able to arrange the effective repair of one of the Western Union Telegraph Company's cables in the vicinity, which contributed somewhat to the revenue profits, and it at once established them in the position of cable repairers and let people know that they were capable of taking on such a class of work, which was usually very remunerative.

Mr. HUGHES-HUGHES (shareholder) complained that there was no balance sheet given to the shareholders, and he strongly urged that they should have a balance sheet published.

Mr. FIGGESS (shareholder) said that with regard to publishing a balance sheet, he begged to support the directors entirely in their views and reasons for not publishing one.

The CHAIRMAN having replied, the motion was put to the meeting and carried *nem. con.*, as was also the resolution declaring dividends of 7 per cent. on the preference shares and 5 per cent. on the ordinary shares.

The retiring directors, Mr. Sydney Gedge and Mr. R. J. Jenkins, were re-elected, as were also the auditors, Messrs. Ball, Baker & Co.

A vote of thanks to the chairman and directors, and a separate one to the officers and staff of the company, terminated the proceedings.

The Notting Hill Electric Lighting Company, Limited.

THE sixth ordinary general meeting of the shareholders of the Notting Hill Electric Lighting Company, Limited, will be held at the company's central station, Bulmer Place, High Street, Notting Hill Gate, London, W., on Monday March 27th, at 5.30 p.m., to (1) receive the report of the directors; (2) receive and pass the audited accounts to December 31st, 1892; (3) elect directors in place of those retiring; (4) elect auditors; (5) transact the ordinary business of the company.

The directors' report reads as follows:—

"The directors beg to submit to the shareholders the accounts of the company to December 31st, 1892. The expenditure on capital account at the date of the last balance-sheet amounted to £67,845 13s. During the year a further sum of £9,054 14s. 7d. has been expended, bringing up the total to £76,900 7s. 7d. Out of this total, £7,110 7s. was expended on mains, and £1,535 3s. 4d. on additional machinery, rendered necessary by the increase in the area supplied. As mentioned in the last report, the directors entered into a contract with Messrs. Crompton & Co., Limited, to extend the mains southward into the Phillimore district, and this work has been carried out at a cost of about £6,500, under the supervision of Mr. Joseph Crookes, to the entire satisfaction of the directors. Similar extensions have been made by the company's own workmen under the supervision of the resident engineer. At meetings held on May 13th and 31st, 1892, powers were taken to issue the balance of the capital, amounting to £29,980, in ordinary preference shares, bearing 6 per cent. cumulative dividend. Of this amount, £7,960 were issued up to December 31st, the proceeds of which were employed towards the capital expenditure above-mentioned. The revenue for the year, which shows a satisfactory increase, amounted to £3,513 12s. 5d.; the revenue from sale of current being £2,518 17s. 1d. for the twelve months, as against £999 10s. 6d. for the previous seven months. The number of houses supplied has increased from 77 to 124, and the number of lights from 6,056 to 9,438. There is every reason to expect a considerable increase for the current year. The mains at present run past and opposite to 886 houses which are not yet taking current. The directors are pleased to be able to report that the machinery and plant at central station, as well as the mains, are in excellent order, and that universal satisfaction is expressed with the steadiness and quality of the light. As the profits of the company depend, after a certain amount of output is reached, upon the amount of annual revenue per lamp, with a view to encourage development in this direction, a sliding system of rebates has been instituted, by means of which the charge for current to consumers, whose lamps yield a gross revenue of upwards of 10s. a year, will be proportionately reduced, the minimum rate being fixed at 6d. a unit. The profit for the year amounts to £112 6s. 1d., which compares with the loss of £554 18s. 6d. (reduced by the return and postponement of undrawn directors' fees to £304 18s. 6d.) for the previous seven months. Having now turned the corner, there is reason to hope that the company will soon yield to its proprietors a return on their investment. In view of the slender amount of net revenue now available, the directors have refrained from drawing any fees during the past year, and do not intend to draw any during the year 1893, until after the results of the working have been ascertained, and the report presented to the shareholders; with a view to further lighten the prospective burdens of the company, they have renounced 50 per cent. of their fees up to and including the end of the year 1893. In consequence of this, no charge for directors' fees appears in the accounts. The directors who retire are Messrs. W. Crookes and S. Waters, and, being eligible, they offer themselves for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., retire, and, being eligible, offer themselves for re-election. They have expressed their willingness, in view of the company's position, to accept a fee of £15 15s."

ABSTRACT OF ACCOUNTS to December 31st, 1892.

CAPITAL ACCOUNT.

DR.	£	s.	d.
To Expenditure per last account	67,845	13	0
„ Further expenditure to December 31st, 1892	9,054	14	7
„ Balance	949	12	5
	£77,850	0	0

CR.	£	s.	d.
By Ordinary shares	64,520	0	0
„ Preference shares	7,830	0	0
„ Founders' „	5,500	0	0
	£77,850	0	0

REVENUE ACCOUNT.

DR.	£	s.	d.
To Generation of electricity	1,510	10	4
„ Distribution of electricity	356	14	3
„ Proportion of rents, rates, and taxes	385	18	2
„ „ „ management expenses	640	4	6
„ „ „ law and parliamentary charges	103	10	10
„ Special charges	106	16	0
„ Connecting Installation and sundry stores	297	12	3
„ Balance	112	6	1
	£3,513	12	5

CR.	£	s.	d.
By Sale of current per meter	2,518	17	1
„ Rental of meters, converters, &c.	121	11	0
„ Transfer fees	2	5	0
„ Other items	870	19	4
	£3,513	12	5

NET REVENUE ACCOUNT.

DR.	£	s.	d.
To Balance from last account	617	5	7
„ Interest on loans	92	16	10
	£710	2	5

CR.	£	s.	d.
By Balance from account	112	6	1
„ Directors' remuneration (specially arranged)	250	0	0
„ Balance	347	16	4
	£710	2	5

GENERAL BALANCE-SHEET.

DR.	£	s.	d.
To Capital account	77,850	0	0
„ Sundry tradesmen and others, on construction of plant, machinery, fuel, &c.	1,549	15	6
„ Sundry creditors on open accounts	485	5	7
	£79,885	1	1

CR.	£	s.	d.
By Capital account	76,900	7	7
„ Cash at bankers } „ Cash in hand }	496	13	10
„ Sundry debtors for current	1,293	14	5
„ Other debtors	37	19	7
„ Stores on hand	502	12	2
„ Stock (movable plant and tools)	305	17	2
„ Net revenue account	347	16	4
	£79,885	1	1

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending March 19th 1893, amounted to £880; week ending March 20th, 1892, £896; decrease £16; total receipts for half-year, 1893, £10,411; corresponding period, 1892, £9,404; increase £1,007.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 17th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,255.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation March 16th.	Closing Quotation, March 23rd.	Business done during week ended March 23rd, 1893. Highest.	Lowest.
195,100*l*	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	101 —104	101 — 104	...	...
1,247,720*l*	Anglo-American Telegraph, Limited	Stock	53 — 54	52½ — 53½	53½	...
2,876,140*l*	Do. do. 6 p. c. Preferred	Stock	92 — 93	92½ — 93½	93⅜	92½
2,876,140*l*	Do. do. Deferred	Stock	13½ — 13⅝	13 — 13½	13 1/16	13
130,000	Brazilian Submarine Telegraph, Limited	10	11¼ — 12¼	11⅞ — 12¼	12⅛	11⅞
34,600*l*	Do. do. 5 p. c. Bonds	100	100 —103	100 —103	...	...
75,000*l*	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	105 —109	105 —109	...	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	3⅛ — 3⅜	3 — 3⅛	3 5/16	3⅛
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2⅛ — 2⅜	2 5/16	2⅛
125,000*l*	Do. do. 4½ per cent. Debenture Stock	Stock	103 —105	103 —105	104½	104¼
40,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	3 — 4	3 — 4	...	...
630,000*l*	City and South London Railway	Stock	37 — 39	37 — 39	38½	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	12¼ — 12⅜	12 — 12½	...	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	10¼ — 10⅜	10¼ — 10⅜	10⅜	10⅜
$7,716,000	Commercial Cable, Capital Stock	$100	175 —180	178 — 182	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ..	14/-	¼ — ⅜	¼ — ⅜	¼	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	5¼ — 5⅜	5¼ — 5⅜	5 5/16	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	12 1/16	11¾
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	9 — 10	9 — 10	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅝ — 11⅞	11⅝ — 11⅞	11⅞	...
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 15	14⅜ — 15⅛	15⅛	14⅞
70,000	Do. 6 p. c. Preference	10	15⅜ — 16⅛	15⅜ — 16⅛	16	15⅞
200,000*l*	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	107 —110	107 —110	...	...
1,200,000*l*	Do. 4 p. c. Mortgage Debenture Stock	Stock	113 —116	113 —116	115	114½
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅛ — 15½	15⅛ — 15½	15½	15 7/16
70,600*l*	{ Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 }	100	103 —106	103 —106	...	...
250,200*l*	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	103 —106	103 —106	...	...
320,000*l*	Do. 4 p. c. Debenture Stock	Stock	111 —114	112 —115	113¼	...
122,400*l*	{ Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343 }	100	102 —105	102 —105	...	...
163,700*l*	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	102 —105	104½	...
300,000*l*	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	101 —104	101 —104	...	...
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	2½ — 3	2⅜ — 3¼	3	2 5/16
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	1/16 — 3/16	1/16 — 3/16	...	...
82,395	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	1/16 — 3/16	1/16 — 3/16	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	0 — ¼	1/16 — 3/16	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	1½ — 2½	1½ — 2½	...	...
180,227	Globe Telegraph and Trust, Limited	10	9⅜ — 9⅞	9¾ — 10	10	9 13/16
180,042	Do. do. 6 p. c. Preference	10	15½ — 15⅝	15½ — 15⅝	15⅝	15½
150,000	Great Northern Tel. Company of Copenhagen	10	19 —19½	19½ — 19¾	19⅞	19½
210,000*l*	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	104 —107	104 —107	107	106½
12,134*l*	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½ — 5½	4½ — 5½	...	...
9,600*l*	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6½ — 7½	6½ — 7½	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	22½ — 23½	22½ — 23½	23⅛	22¾
200,000*l*	Do. do. 4½ p. c., Deb., 1896	100	104 —106	104 —106	...	...
17,000	Indo-European Telegraph, Limited	25	44 — 46	44 — 46	43¼	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000 ...	10	2½ — 3½	2½ — 3½	...	...
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6 — 7	6 — 7	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4½ — 4⅝	4⅝ — 4⅝	4½	4 1/16
10,000	Do. do. fully paid	5	5⅝ — 6	5 11/16 — 5 13/16	5⅝	...
38,348	London Platino-Brazilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000*l*	Do. do. do. 6 p. c. Debentures	100	106 —109	106 —109	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£9 paid)	10	6½ — 6⅝	6 — 6½	6½	6 3/16
50,000*l*	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	102 —105	102 —105	105	104½
454,747	National Telephone, Limited, Nos. 1. to 438,984	5	5⅛ — 5⅜	5¼ — 5⅛	5 1/16	5⅛
15,000	Do. 6 p. c. Cum., 1st Preference	10	14½ — 15½	14½ — 15½	15	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13⅞ — 14½	14 — 14½	14½	13⅞
90,950	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5⅜ — 5⅝	5⅜ — 5⅝	5⅝	5½
726,477*l*	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —116	113 —116	113¾	...
48,800*l*	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,318	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	5½ — 6½	5½ — 6½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	⅛ — ¼	⅛ — ¼	⅛	...
11,802	Reuter's Limited	8	7 — 8	7 — 8	...	...
18,680	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	8¼ — 8⅜	8¼ — 8⅜	8⅜	8¼
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8¼	...
3,381	Submarine Cables Trust	Cert.	118 —123	118 —123	120	119
78,949	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	3 — 3½	3 — 3½	3 3/16	3½
37,350	Telegraph Construction and Maintenance, Limited	12	34 — 37 xd	34 — 37 xd	35½	34¼
150,000*l*	Do do. do. 5 p. c. Bonds, red. 1894	100	101 —104	101 —104	...	...
58,000	United River Plate Telephone, Limited	5	2½ — 3	2½ — 3	...	...
146,370*l*	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 — 100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	6½ — 7½	6½ — 7½	...	...
260,900*l*	Do. do. do. 5 p. c. Debentures	100	100 —103	100 —103	102¼	101½
30,000	West Coast of America Telegraph, Limited	10	2½ — 3½	2½ — 3½	...	...
150,000*l*	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	105 —109	105 —109	...	...
64,242	Western and Brazilian Telegraph, Limited	15	7⅞ — 8¼	7⅞ — 8¼	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5⅞ — 6¼	5⅞ — 6¼	6	5⅞
33,129	Do. do. do. 5 p. c. Deferred	7½	2 — 2½	2 — 2½	...	...
184,100*l*	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	105 —108	105 —108	...	...
230,100*l*	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	105 —108	105 —108	106⅞	106
88,321	West India and Panama Telegraph, Limited	10	1½ — 1⅝	1½ — 1⅝	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	10⅜ — 11¼	11 — 11½	11¼	11⅛
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	107 —110	107 —110	109½	108
$1,536,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	120 —125	120 —125	...	...
171,000*l*	Do. do. 6 p. c. Sterling Bonds	100	101 —104	101 —104	102	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5½ — 6	5½ — 6	5 13/16	5 11/16

* Subject to Founders' Shares. † Quotations on Liverpool Stock Exchange. Bank rate of discount, 2½ per cent. (January 26th, 1893.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅞—7⅞.—Brush Company 4½ per cent. Debenture stock, issued at 1 per cent. premium, 100—103.—Electric and General Investment, shares of £5 (£1 paid), 1⅞—2¼.—Founders' shares, 200—225.—Electric Construction Corporation, 6 per cent. Debentures, 95—98.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—Elmore Foreign and Colonial Copper, Founders shares, 6⅞—7¼.—European Sims-Edison Torpedo Company, shares £20 (fully paid), 20—20½.—Founders' shares, 10—20.—Halifax and Bermuda Cable 4½ per cent. bonds 80—90.—House to House Company (£5 paid) 1¼—2½.—Do. 7 per cent. Preference of £5, 5—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 5—5½, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6—6¼.—Liverpool Electric Supply Shares of £5 (fully paid), 5⅜—6.—Manchester, Edison and Swan Company, £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating, Debentures, 101—103.—Woodhouse and Rawson £5 Preference (fully paid), ⅜—1½.

‡ Unless otherwise stated all shares are fully paid.

WROUGHT v. CAST-IRON FOR FIELD MAGNET FRAMES.*

BY A. D. ADAMS.

THE modern bi-polar dynamo may be broadly divided into two essential parts, the field magnet and the armature.

The office of this armature is to conduct magnetism through its core, and cut or cross this magnetism by means of its windings or inductors.

The office of the field magnet is to conduct magnetism from one side of the armature to the other, and usually to carry the field coils.

It is entirely possible to draw a current from an armature when revolved within an exciting coil, even though it have no field magnet to complete the magnetic circuit.

One objection to such an arrangement would be the excessive amounts of copper and energy required in the exciting coil for a given effect, as the lines of magnetism would have to pass through the air in order to complete the magnetic circuit from one side of the armature to the other.

The great advantage of the combination of the armature and field magnet over the above arrangement lies in the fact that the field magnet forms a magnetic path of much less resistance than the air.

The same reasoning that leads to the completion of the magnetic circuit through the field magnet seems to indicate that the best metal for this purpose is that having the greatest magnetic capacity and permeability per unit of area and cost.

The aim in this paper is to point out some of the advantages of wrought-iron over cast-iron for the field magnet frames of bi-polar dynamos.

The researches of Prof. Ewing and Dr. Hopkinson show that the same magnetising force per unit of length, as measured in ampère turns, which produces in good hammered scrap iron a magnetisation of 100,000 lines per square inch, produces in good gray cast-iron only about 42,000 lines per square inch, and these values are about as high as we can go in either of these metals and get anything like a proportionate increase in magnetism for increase in magnetising force.

If, then, the same number of ampère turns are to be used for a given length of magnetic circuit, cast-iron must be about two and a half times the section of wrought-iron.

Since the field magnet, to have the same magnetic carrying capacity at the same permeability, must have about two and a-half times the section when made of cast as when made of wrought-iron, the weight of cast-iron for the same type and capacity of machine will be about two and a-half times that of wrought.

In order to compare the relative amounts of copper required in field magnet windings for machines of the same capacity, but with different metals in the field magnet, the same wattage or exciting current must be assumed for all types.

Take two machines of the same type and capacity, with the same length and section of air gap between the armature core and pole pieces, and let one field magnet be made of wrought and the other of cast-iron, throughout, each having the field magnet core circular in section, and the area of the cast-iron core two and one-half times that of wrought.

Since the ampère turns required on each magnet are equal, also the watts expended in winding, there will be the same number of turns of wire on the cast-iron as on the wrought-iron field.

As the two field cores are circular in section and one two and a-half times the area of the other, the length of wire required around the cast-iron will be to that around the wrought-iron core as

$$\sqrt{2\tfrac{1}{2}} : 1.$$

Since the weight of copper required to transmit a given amount of electric energy at a given pressure and loss varies as the square of the distance, the weight of copper on the cast-iron will be to the weight of copper on the wrought-iron core as

$$(\sqrt{2\tfrac{1}{2}})^2 : 1^2 = 2\tfrac{1}{2} : 1.$$

The general practice among American manufacturers of bi-polar dynamos and motors is to use either cast-iron entirely, or cast-iron yokes and pole pieces and wrought-iron cores.

In the latter case the sections of the cast-iron parts are usually made only about one and a-half times that of the wrought-iron.

With these proportions between the wrought and cast-iron, either an excessive amount of magnetising force must be expended to drive the magnetism through the pole pieces and yokes, or else the wrought-iron core must be only saturated to a very low degree.

The amount of copper or field current must be, in either case, considerably increased above that required when the cast and wrought-iron parts have their correct relative proportions.

Magnetic leakage is considerably increased by the use of cast-iron, as compared with wrought-iron, by reason of the greater surface of the cast-iron, also the much higher relative degree of saturation at which it is frequently used.

It is evident from the above that the weight of iron and copper for the field magnet and winding in a machine of given capacity are both more than twice as great when cast as when wrought-iron is used entirely.

When the field magnet is made partly of cast and partly of wrought-iron, the increase of iron and copper is not so great, and varies with the relative section of the cast and wrought-iron parts.

The advantages of wrought-iron over cast for the field magnets of bi-polar dynamos seem to be more generally appreciated in England than with us, as nearly all the leading makers of such machines there use forged wrought-iron entirely for field magnet frames.

As the relative magnetic value of wrought and cast-iron becomes more generally appreciated by dynamo builders in this country, the former will, no doubt, be much more generally adopted.

The following data of a 2-H.P. 110-volt motor, designed by the writer, and having a forged wrought-iron field magnet throughout, may be of interest as illustrating some of the above points :—

Type of motor, bi-polar.
Type of armature, smooth core, Gramme.
Weight of motor, 250 lbs.
Speed of armature without load, 1,700 revolutions per minute.
Turns of wire on the armature, 360.
Size of wire on the armature, No. 15 B. & S. gauge.
Weight of armature wire, 3·7 lbs.
Resistance of armature, cold, ·32 ohm.
Resistance of field coil, cold, 140 ohms.
Current in field coil, ·78 ampère.
Wire in field coil, 26 lbs., No. 21 B. & S. gauge.

Particular attention is called to the number of indicators on the armature of this machine, namely, 360, which is very small when its weight and the moderate speed at which it runs are taken into consideration.

It is very evident that these results could not have been obtained had cast-iron been used, either wholly or in part, for the field magnet.

It may be pointed out that the weight of wire and the energy required for field excitation might have been considerably reduced had it been thought best to reduce the length of the air gap, but it was desired that the field exciting force should practically overcome the tendency of the armature to distort the magnetic field in the air gap, which result has been obtained by the above construction, so that no change of lead with the brushes is necessary when the load of the motor is varied from nothing to its full capacity.

* Abstract from paper read at St. Louis Convention.

Edinburgh Electric Lighting.—The Lord Provost's Committee of Edinburgh Town Council met last Friday for the purpose of considering the report of Professor Kennedy on the electric lighting of the city. Some of the members of the committee were strongly averse to the Corporation having anything to do with the working of the electric light, while others were in favour of the management being undertaken by the Council. The meeting broke up without coming to any resolution on the subject.

SOLIDIFIED AIR.*

No sooner have we become accustomed to the idea of liquid air, than we receive the news of its solidification, and are forced one step nearer to that negative goal—the absolute zero. Prof. Dewar is again the pioneer, his latest results having been communicated to the Royal Society on the 9th inst.

The method of solidification adopted was a development of that which has already been successfully used for attaining liquefaction. It will be remembered that on the occasion of the last lecture on this subject at the Royal Institution, the device of screening the vessels containing liquid oxygen from the heat of the room by means of a vacuous envelope, was shown to be the most efficient means which had been discovered for the purpose. In the case of still lower temperatures, as in the solidification of air, a double envelope was used, and found to be a still better screen. Protected by this double envelope, liquid oxygen, liquid nitrogen, and liquid air have all been subjected to the lowest temperature that can be attained by their own evaporation under diminished pressure, produced by an exhaust pump. A difference in their behaviour is at once noted. Nitrogen evaporates and freezes, oxygen evaporates without freezing, and air evaporates, giving off its nitrogen before its oxygen, and the residue, richer in oxygen, appears to freeze. We say "appears to freeze" advisedly, for, in view of the fact that oxygen alone cannot be induced to solidify, it appears doubtful whether the solidified air is really a mixture of solid nitrogen and solid oxygen, or only a mixture of solid nitrogen and liquid oxygen, the latter being entangled and prevented from separating much as water is entangled by solid gelatine in a comparatively weak solution of that substance, which has been allowed to "set." But substances that exhibit this property of apparently solidifying liquids at temperatures above their freezing points are colloids, a fact that leads to the conclusion that solid nitrogen is a colloid, and *ipso facto* possesses gigantic molecular aggregations, a conclusion that could scarcely be accepted without further and more convincing evidence. It seems much more probable that the body which Prof. Dewar has obtained is true solid air, in which both the oxygen and nitrogen are frozen, and that the reason for the solidification of the oxygen, in spite of the fact that it does not solidify when treated alone by the same process, is simply that the greater volatility of the nitrogen with which it is mixed, causes a larger absorption of heat than can result from the evaporation of pure oxygen, and thus abstracts enough heat from the residual oxygen to lead to its solidification. If this be so, it will perhaps prove possible to solidify oxygen by surrounding it with a vessel containing liquid nitrogen, and connected with an exhaust pump.

If Prof. Dewar continues his researches with the energy and success that have hitherto characterised them, we do not despair of announcing in a few weeks' time that a trial casting of liquid hydrogen has been made, and that on solidification and removal from the mould, it has proved to possess a fine lustre, high tensile strength, and sonorous qualities—quite in accordance with its known metallic character.

THE ELECTRIC LIGHTING OF SZEGEDIN.

THE City of Szegedin, the largest and most important provincial town of Hungary, has invited a competition for securing public and private lighting by means of gas or electricity. In this town a lively demand for the electric light has appeared for some years, and, in particular, the Municipal Theatre has long wished to introduce this kind of illumination. But the agreement concluded with the gas company formed an insurmountable obstacle, and so they were obliged unwillingly to put up with gas light. As the gas agreement expires in 1895, the municipal authorities have already invited a competition which may have interest for extended circles, and which I therefore reproduce as follows :—

* *Industries.*

SZEGEDIN.

Competition for Public Lighting.

Since the undertaking for public lighting in the Imperial Free City of Szegedin expires with the end of October, 1895, a competition is invited for lighting, beginning at this date, and with due regard to the following principles :—

I.—*Fundamental Determinations.*

1. The municipal streets and places to be lighted with electricity or gas, for which the competition is invited, are fixed as follows :—*a*, the square between the great Ring-strasse and the river Theiss ; *b*, the upper Theiss Quay to the Fabriks colony ; *c*, the Vésárhelyer ; *d*, the Esongráder ; *e*, the Budapest ; *f*, the Calvarien ; *g*, the Szabadkaer ; *h*, the Szt Häronság ; *i*, the Boldogasszony ; *i*, the Kerteszgasse to the new Cavalry Barracks ; *k*, the New Szegedin Popular Garden Main Avenue up to the Rotunda ; *j*, the Strassen Bridge.

The other part of the city is for the present to be lighted with the existing lamps and those to be brought from the above-mentioned district. The length of the streets to be provided with public lighting is about 45 kilometres, and the space of the public spaces to be illuminated amount to about 180,000 square metres. The tender may refer either to electric lighting alone, or to gas light alone, or both together. The unit of the intensity of light of the flames is 16 normal German candles. The mutual distance of the 16-candle flame is, on an average, 20 to 30 metres. In case of electric lighting, arc lights may be substituted for glow lamps of corresponding power ; in case of gas lighting, single burners may be replaced by collective burners or lamps with multiple flames. The town retains the right, outside the above-mentioned space, to extend the light without any fees. Hence the tenders must be so drawn up that the mains, electric leads, may be arranged so that the further development of the lighting may be carried out without any difficulties.

II.—*Conditions for the Competition.*

A. *In Case of Electric Lighting.*—For what time does applicant wish to secure the exclusive concession, and on what conditions, after its expiry, does the entire installation revert into the possession of the City of Szegedin ? Are the conditions of an earlier redemption detailed ? The unit price of glow and arc lamps for 100 watts, and per hour, and the ultimate reduction of price, *a* for the general lighting, *b* for horse-power. The unit price for private, *a* for lighting, *b* for horse-power. What concessions are secured to the city, in particular, what percentage of the income and from that date will be handed over to the city ? Does the applicant claim any fundamental tax, and what is the hire of the meters, *a* for the city and *b* for private consumers ?

B. *In Case of Gas Lighting.*—For what time does the applicant wish for the exclusive concession, and under what conditions, on its expiry, does the entire installation pass into the possession of the city ? Particulars as to an earlier redemption must be stated. Unit price for 16 normal candle flame (German) per hour, for public service, *i.e.*, unit price for cubic metre, *a* for the city, *b* for private consumers. Unit price per cubic metre for industrial uses ? What concessions does applicant secure to the city, further and especially does he offer a certain percentage, and from what date ? What does he charge for the hire of meters ? What system of illumination does he wish to employ ? What are the dimensions of the mains and their position, and what kind of lamps will he employ ? From what point of time, after the grant of the concession, does the the lighting commence for the city and for private consumers ?

III.—*Supplemental Determinations.*

The City of Szegedin submits the tenders to the revision of an expert commission, and reserves the right to select freely among the tenders, or with the consent of the applicants, to distribute the concession among the candidates. The city further retains the right to carry on negotiations in detail with the applicants, with the remark that the fundamental principles hold good as general principles.

Tenders are to be handed in to the Magistracy of Szegedin up to September 1st, 1893.

(Signed) F. FALFY, *Burgomaster.*

REVIEWS.

The Standard Electrical Dictionary: A popular dictionary of words and terms used in the practice of electrical engineering. By T. O'CONOR SLOANE. London: Crosby Lockwood and Son.

This work is of American origin, being compiled in America by an American; naturally therefore it bears an American impress, though to a very limited extent. It might perhaps be doubted whether, in the face of the fact that a somewhat similar compilation (that of Houston) has already been brought out, there is room for another book of the kind. This we think can fairly be answered in the affirmative, as the work before us has many attractive features in it, and it is beyond doubt a well put together and useful publication.

The amount of ground covered may be gathered from the fact that in the index about 5,000 references will be found.

As an instance of the cosmopolitan nature of the book, we may take "Quadruplex Telegraphy," a system of almost purely American origin. Here we should naturally expect to find a description of the same as it exists in the States; actually, however, we have the diagrams and description of the system as it is worked in the General Post Office, England. The same applies to Duplex Telegraphy.

The inclusion of such comparatively modern words as "impedance," "reluctance," &c., shows that the author has desired to be up to date, and indeed there are other indications of carefulness of compilation.

A very careful scrutiny of the whole book would no doubt reveal matter for criticism, but it would reveal far more for commendation. The work indeed is one which does the author great credit, and should prove of great value, especially to students.

Journal of the Institution of Electrical Engineers. Nos. 102 and 103. London: E. and F. N. Spon, 125, Strand.

The general contents of these numbers are as follows:—

No. 102.—Discussion on Dr. Fleming's paper on "Experimental Researches on Alternate-Current Transformers;" description of a new form of "Direct-to-Alternating Current Transformer," of very high frequency, by Sir David Salomons.

No. 103.—Continuation of discussion on Dr. Fleming's paper; inaugural address of new president (Mr. W. H. Preece).

Manuel de L'Ouvrier Monteur Electricien. Par J. LAFFARGUE. Paris: Bernard Tignol, 53, Quai des Grands-Augustins.

This work is a *résumé* of a series of lectures delivered at the Syndicat Général des Chauffeurs-Mécaniciens de France et d'Algérie. The title hardly indicates the nature of the contents, dealing, as the latter does, with electric light work exclusively.

The volume is divided into 12 parts, as follows:—1. General Definitions; 2. Dynamo Machines; 3. Distribution of Electrical Energy; 4. Methods of Distribution; 5. Canalisations in the Streets; 6. Inside Canalisations; 7. Lamps and Motors; 8. Accidents caused by Electric Distribution—Means of remedying the same; 9. Practical Instructions for Electricians; 10. Electric Installations of Paris; 11. Rules and Regulations adopted in various parts of the World; 12. Practical Questions and Answers. Speaking generally, the book is very similar to that of Urquhart on "The Electric Light," with, of course, a strong French flavour about it, as would naturally be expected. It is, however, undoubtedly a good book, and possesses sufficient originality to make it a useful addition to the ever-growing crop of compilations of the kind.

LEGAL.

W. T. HENLEY'S TELEGRAPH WORKS COMPANY, LIMITED, *v.* SCOTT.

In the Queen's Bench Division on Monday, Lord Justice A. L. Smith heard this case. Mr. Ram was counsel for the plaintiff company; Mr. R. T. Reid, Q.C., and Mr. Arnold White appeared on the other side.

Mr. RAM stated that the defendant, Mr. R. A. Scott, was a gentleman who manufactured electrical instruments and appliances for the Admiralty and others. The action was to recover £298 for goods supplied in 1892. Mr. Scott sought to deduct about £230 from the claim. Mr. Scott, in September, 1891, had received an intimation from the Admiralty that he might tender, amongst other things, for the manufacture of certain cable. Mr. Scott asked the plaintiff company for a quotation, and by arrangement, Mr. Potter, the company's representative, and Mr. Russell, the representative of Mr. Scott, met at the Admiralty Pattern Office. Mr. Russell had not the specification with him, but he had a summary of it, which gave the numbers, and they saw the patterns. The plaintiffs did not make cables insulated in the particular way required, so they communicated with Messrs. Fowler, Waring & Co. Samples were sent by the plaintiffs to Mr. Scott, with the suggestion they should be compared with the Admiralty patterns. On October 29th, the order was given by Mr. Scott to the plaintiffs for the cable, the letter setting forth it must be distinctly understood that the whole of the responsibility of rejection by the Admiralty officials was to be borne by the plaintiffs, as well as expenses attendant thereon. The difficulty arose in consequence of the Admiralty having issued a second specification which indicated the cables by the same figures, but under which they had to be made differently. It was the practice of the Admiralty to send out copies of all altered specifications to the firms who were in the habit of tendering, and since the plaintiffs had supplied the goods they found they had received one of them, but they did not of course know that it referred to Mr. Scott's order. Under the later specification the cable had to be insulated with vulcanised India-rubber, instead of jute yarn and lead.

Mr. POTTER, the plaintiffs' traveller, was called to speak as to the interview at the Pattern Office. In cross-examination he denied that Mr. Russell pointed out to him that the patterns were quite out of date, and that the cable would have to be made entirely by the specification. He did not himself recollect remarking that the patterns must have been there ages. They might have been. When they asked Fowler, Waring & Co. for samples, they gave them the numbers. A man accustomed to looking at cables could see at a glance they were insulated with jute covered with lead. He could not say that the Admiralty attached no importance to samples, merely regarding them as specimens of workmanship, and went entirely by the specification.

By Mr. RAM: Had they been aware of the later specification, they could have done all but the lead covering at their own works, and got their ordinary profit out of the transaction. The company now made lead covered cables.

Mr. W. N. GARBUTT, works manager to Fowler, Waring & Co., stated that the cables in question were made in accordance with the latest Admiralty specification they had.

Cross-examined by Mr. REID: As a rule the Admiralty continued the numbers in the specifications, so that if they received an order they would take the latest. They sent samples.

Mr. REID: The defendant sent the samples on without examining them, and the India Office lost them.

Mr. GARBUTT: We did not know of the later specification. We should not have been asked for vulcanised India-rubber covers, as we do not make them.

Mr. RAM: Since this matter arose the Admiralty have used different numbers.

Mr. REID: I am very glad to hear it. I will call Mr. Russell.

Mr. C. N. RUSSELL, an electrical engineer, said that at the date in question he was manager to Mr. Scott. He remembered meeting Mr. Potter at the Admiralty room. He had the specification and the estimate with him. He would not have been allowed to see the patterns without those documents. They were shown to Mr. Potter. They noted that the patterns did not compare with the specification. The patterns were obsolete. The patterns were jute insulation, whilst the specification distinctly stated it had to be vulcanised rubber. They were tendering for other things besides cables. Witness opened the samples which were sent. They were vulcanised India-rubber. He had a clear recollection of that.

LORD JUSTICE SMITH: But Fowler, Waring & Co. do not make that.

Mr. RUSSELL, continuing his evidence, said he informed Mr. Potter that owing to the cables not being made to specification, they had had to purchase them elsewhere at a loss. Mr. Potter said he did not remember the specification. Upon that witness showed him the duplicate.

Cross-examined by Mr. RAM: That was six or seven months after the order had been sent in. Mr. Potter did not, upon reading the specification, say: "I am certain I never saw this." The summary produced, which was in the handwriting of Mr. Scott's clerk, related to the whole of that part of the specification in which the plaintiffs would be interested. The clerk would have made the analysis at his (witness's) request. All the samples in the Admiralty room were jute and lead. Vulcanised insulation was about 25 per cent. dearer than jute. The figure the plaintiffs tendered at would have been very low for the vulcanised, but that was not noticed at the time.

By Mr. REID: He had never bought any lead covered cables before.

M. R. A. SCOTT, the defendant, said he was an electrical and general engineer. He had 10 or 11 years' experience as a Government contractor. He did not notice anything about the price quoted by the plaintiffs for the cables. He filled in the price to make his tender complete, never for a moment expecting to get that part accepted, not being himself a cable manufacturer. The samples sent on were vulcanised India-rubber undoubtedly, and none of them lead covered. The plaintiffs must have made a mistake, and sent a set of their own samples, and not Fowler, Waring & Co.'s at all. They must have got mixed. The plaintiffs sent away hundreds of sets of samples of vulcanised cable. Eventually they refused to supply vulcanised goods, and he had to buy them elsewhere for £342. The other price was £231. In his view the plaintiffs had to pay him a balance of £52.

Cross-examined by MR. RAM: He tendered to the India Office without in the least expecting to get the order for the cables. He did not answer the plaintiffs' letter when the dispute first arose, telling them they had sent him no lead cased samples. He (defendant) was not relying upon the samples, but upon the specification.

MR. THOMAS MORRIS, the keeper of patterns at the Government office, said that any person wanting to see them must either produce a form of tender, or a written order from the director of naval contracts. He recollected Mr. Russell producing the estimate form, and the specification from the India Office, and witness remarked that was all right. He told Mr. Russell, in the hearing of Mr. Potter, that the specimens on the board were not the form of goods required, but they must be strictly in accordance with the specification.

MR. RICHARDS, electrician to the Board of Admiralty, said they had tried to find the samples in question at the India Office, but could not. They did not ask for samples in the contract, or they would have been returned in the contract. The few samples they did get were not lead covered. One was vulcanised insulation, the other two were pure rubber. Witness compared them with the specification. He did not remember having received more than three samples. He prepared the specification himself. If he had had a jute sample he would not have passed it.

LORD JUSTICE SMITH: It seems to me the difficulty will be as to what samples were sent by the plaintiffs to the defendant.

MR. POTTER, recalled and questioned by MR. REID, said his company sent out a good many hundred samples during the year. They had no record of them beyond the correspondence. He himself did up the lead covered samples in the parcel for post, and addressed the label to Mr. Scott.

On Tuesday Mr. Ram obtained leave to recall MR. POTTER, who produced the postage book, showing that a letter had been posted to Mr. Scott upon the date in question, and a parcel. The cost of the latter was 4½d., and that, he said, would be sufficient to cover the postage of the two sets of samples. The lead-covered cable was done up in a brown paper parcel.

MR. SCOTT and MR. RUSSELL, questioned by MR. ARNOLD WHITE, both stated they had no recollection of receiving such a brown paper parcel.

MR. RAM having addressed the Court on behalf of the plaintiffs,

LORD JUSTICE SMITH said the case was one of considerable perplexity. He had not come for many years across a cause in reference to a mercantile contract in which there had been such a conflict of evidence. He did not think the gentlemen called on the one side or the other had wilfully come there to tell him what they knew to be untrue. But that one side or the other had made a blunder was beyond all doubt. He had to do the best he could to find out where the truth was. The whole of the case turned upon what took place at the interview on September 16th between Mr. Potter and Mr. Russell. There existed at that time two Admiralty specifications for cable. Under the specification of April, 1890, the Government took submarine cable that was insulated by jute, and under that of June, 1891, they required the cable to be insulated with India-rubber. Both cables were to be covered with lead. The gentleman who came from the Admiralty said that he had had too much trouble with the jute insulation, so that they had brought out the new specification. Mr. Potter and Mr. Russell met at the Admiralty Pattern Office, and Mr. Potter said he did not see the specification because Mr. Russell had left it at home, but he was supplied with an extract giving the numbers. He saw the patterns, upon which he contracted that the plaintiffs were to make samples of jute insulation. He might have said, "These patterns have been here for ages." That was an expression which he (the Lord Justice) thought had some bearing in this case. Mr. Russell went into the box and stated that, besides the document referred to by Mr. Potter, he had the specification and the estimate with him. It seemed to him (Lord Justice Smith) that the plaintiffs' case on this part failed. Mr. Russell stated he could not have obtained admission to the pattern room unless he produced the specification or estimate, and he was corroborated by the keeper (Mr. Morris), who had no interest in this case at all, who declared that unless a person had an estimate, or a specification, or a Government order, he never let anybody in. That evidence was strong to show that Mr. Russell was telling the truth, and that Mr. Potter's memory was inaccurate. Therefore he had come to the conclusion that the plaintiffs had failed to make out that the order was given upon the jute pattern, and not upon the specification. Then it was pointed out that the words "jute and lead" were inserted upon the extract in pencil by Mr. Potter. It appeared to him that the words, whenever put on, as to which Mr. Potter was not quite clear, were a blunder on the part of that gentleman. He (the Judge) was satisfied the order was for India-rubber and not jute-covered cable. Next came the part of the case he did not understand. It seemed clear that Fowler-Waring sent samples to the plaintiffs, but whether they got further he did not know. He was perfectly certain the jute samples did not get to the Admiralty, or they would have at once repudiated them. He had come to the conclusion that the plaintiffs had not proved that the defendant entered into a contract with them to have the cable made according to the pattern seen at the Admiralty Office, but that it was, in reality, to manufacture according to the specification which the defendant then had. In those circumstances, his judgment would be for the defendant both on the claim and the counter-claim, the result being that the plaintiffs owed the defendant £44 2s. 11d.

MR. RAM submitted that no costs should be given. It was a matter of very great difficulty and conflict, and until the plaintiffs came into Court they had no notion it was going to be relied upon that the samples had not been received.

LORD JUSTICE SMITH: They who lose must pay.

THE TESLA LECTURE AT ST. LOUIS.

WE are indebted to the editors of the New York *Electrical Engineer* for an advance proof of the following article:—

The Tesla lecture was a notable feature of the convention. At first it had been proposed to deliver the lecture in a small hall, but the demand for tickets was so enormous, that it was decided, as a matter of sheer necessity, to secure a larger auditorium, and this was found in the Exhibition Theatre, which seats about 4,000 people. It was, of course, practically impossible that all could hear and see; but those who were there could at least say they had seen Mr. Tesla afar off, and witnessed some of his most striking experiments. The hall was crowded to suffocation, and the demand for tickets was so great, that they were selling briskly for three and five dollars on the steps of the hall. Under such circumstances, Mr. Tesla contented himself wisely with showing some of the more "spectacular" of his experiments, and even these were followed at a disadvantage in view of the immense distance from which most of the spectators studied them. After his introduction by Mr. Ayer, the lecturer gave a few minutes to a statement of the conditions involved in his work, and then by means of his high frequency and high voltage currents, aided by disruptive discharge from a condenser through an induction coil—as well as by direct dynamic phenomena, he produced a number of the interesting results that have already made his name famous, and have charmed two worlds. He received, unhurt, currents of hundreds of thousands of volts, lit up tubes and lamps through his body, rendered insulated wires several feet long entirely luminous, showed a motor running under the influence of these million-frequency currents, obtained a number of effects with phosphorescent lamps; and also showed how little in such work the high resistance of the filament had to do with the lighting up of ordinary 50 or 110-volt lamps. His ability to produce such effects, either with a single wire and no return, or without any wires at all, aroused the utmost interest and enthusiasm, and the concluding demonstration literally brought down the house, when he showed how, by simply carrying lamps or tubes into a room or hall where those currents were being developed, illumination was the immediate result.

In his opening remarks Mr. Tesla enlarged upon the grandeur of Nature, and expressed his opinion that the most wonderful of the external influences that affect us is light. Hence it followed that the most wonderful and important of the organs by which these external influences beat in upon us is the eye. Two facts were specially referred to, one of them being that the eye is the only organ capable of being affected directly by the vibrations of the ether. Another fact was that the eye would be able to distinguish objects at almost any distance, were it not for the minute particles and stray gases filling the intervening space. These absorb the energies of the ether vibrations, but in a pure medium they would travel unchecked, and the range of vision would be infinitely greater. Mr. Tesla then alluded to the importance of the part played by the eye in furnishing the race with its ideas and knowledge, and to its vital function in controlling all our motions and actions. From its teaching were derived consciousness, ideas, conceptions that were possible without images—and images involved sight.

By these interesting stages Mr. Tesla led up to the subject of light, and thence to the part of electricity in giving us light. The general aim of the discourse was to show and explain the phenomena due to electrostatic forces, followed by phenomena produced by electro-dynamic agencies; and then, as a third class, the light effects, Mr. Tesla's idea evidently being to give a generalisation of these phenomena, and of their relations. It was stated, parenthetically, with regard to the physiological effects produced with the high tension, high frequency currents employed, that a great amount of energy may be sent into the body of a person by their means, merely because the energy was dissipated laterally from the body and was not passed through the body in the direct manner involved in the use of a low frequency current. It was due to this intense rapidity of vibration that the lecturer was able to receive with impunity currents of as high as 250,000 and 300,000 volts, and of an amount which otherwise administered would kill. The lecturer explained that he had so arranged his apparatus that in case of any failure of any part of it, the current would kindly abstain from killing him, and would only knock him down.

Many of the experiments shown have already been seen either in this country or in Europe, yet there were several novel effects introduced, and even the familiar experiments were performed with apparatus different from that used before. In most of the experiments the ordinary alternating and continuous currents from the central station were used, although Mr. Tesla also had his own special generator running in the basement.

A striking new experiment was to show at the beginning of the lecture the effect of a varying electrostatic stress through the dielectric. This experiment was performed by grasping one terminal of the high tension transformer giving about 200,000 volts pressure, and approaching the other hand to the opposite terminal. Streams of violet light then issued from the fingers and the whole hand. (At the lecture on the preceding Friday at the Franklin Institute in Philadelphia, Prof. Houston noticed these streams of light coming, also, from the lecturer's back, following, roughly, the line of the vertebral column.)

Another experiment was performed showing the action of the air between two condenser plates. By attaching these plates to the high-tension transformer, the whole space between these plates was filled with light, the distance apart being about 10 inches. It was pointed out that these streamers consumed considerable energy and developed abundantly ozone and nitrous acid, and it followed that it was necessary to exclude air from high-tension apparatus.

The action of the air was shown in another very striking experiment. Two incandescent lamps exactly alike, one exhausted, the other not, both of the ordinary 50-volt type, were attached in multiple

arc, and a current vibrating about one million times a second, or thereabouts, was passed through the filament It was demonstrated that the lamp which was exhausted glowed brightly, whereas the other one, in which the filament was surrounded by air, at ordinary pressure, did not glow. Yet the latter lamp got hotter than the other. This showed the great importance of the rarefied gas in the heating of a conductor, and it was pointed out that in incandescent lighting a high resistance filament does not at all constitute the really essential element of illumination along these lines. Also that heavy blocks of metal may be brought to incandescence by minute currents provided they are surrounded by rarefied gas, and provided the potential and frequency of the currents is sufficiently high.

One of the most interesting experiments was the conversion on open circuit. A transformer was taken and the current passed through the high tension winding in such a way that only one terminal was attached to the source of the rapidly alternating current. In spite of this there was a current passing through the primary as though the other terminal was actually attached to the source like an ordinary return circuit. This open circuit transformer contained a secondary low tension winding, and the minute currents passing through the primary were transformed into currents capable of following the ordinary electric wire and lighting up brilliantly an ordinary lamp. It was pointed out that under certain conditions, indeed, such a conversion was quite practicable, and that it can be practised with high economy. It was further pointed out that any kind of device such as motors, &c., may be operated in this manner, with one wire or circuit only.

Mr. Tesla, in the course of his lecture, dwelt upon his method of conversion by means of disruptive discharges from continuous or alternating station supply. There were two kinds of apparatus on the stage, one operated from the alternating circuit and the other from the regular direct current system. A peculiar form of discharger was used, contained in a mica-lined wooden box. The spark-gap was warmed by a small lamp underneath, for the purpose of making the air dielectrically weak. This enabled Mr. Tesla to work with a very long gap, a very sensitive arc, and a comparatively small electromotive force in the gap. The effects obtained were thus augmented very materially. It was pointed out that with this method of conversion there is no difficulty whatever in obtaining sparks of any length. It becomes simply a question of the energy supplied through what distance the spark will be visible. During the lecture, lamps were operated by this method of conversion. An ordinary 100-volt, a 50-volt and a 2-volt lamp were brought up to full candle-power with equal facility. Then a little motor was run by means of these disruptive discharges, it being a phase-motor comprising simply an iron core with a closed secondary coil in it, and a disc armature arranged to rotate above the core. Mr. Tesla remarked rather naively that if the demonstration were not quite equal to the expectation, the long continued and weary work on the development of the invention, besides the inability of the experimenter, might be the cause. He went on, in connection with this, to refer to the transmission of power from Niagara, and gracefully recognised the presence on the platform of Prof. George Forbes, who is so prominently identified with this great work. Mr. Tesla believed that we were about to see such great powers transmitted long distances, and over one wire.

Continuing, Mr. Tesla remarked that he had shown things of a more spectacular nature with reluctance, yet forced thereto by the desire to gratify those who had shown their interest and formed so large an audience. A number of experiments were performed not seen in this country before, though some had been shown in England. For instance, a phosphorescent bulb was lighted up by being merely held in the hand, and this was a most successful experiment. Mr. Tesla prefaced it by relating a little anecdote of Lord Rayleigh. When he was in London, remarked Mr. Tesla, with much feeling, he had the pleasure of performing this experiment privately before Lord Rayleigh, and he would always remember the trembling eagerness and excitement with which that distinguished scientist witnessed the lamp lit up. The appreciation of such men, said Mr. Tesla, repaid him fully for the pains he had been at in working out these phenomena.

In this experiment a number of tubes were taken and flourished or flashed in various ways, and with the current made intermittent at longer intervals by adjusting the spark gap. Wonderfully beautiful effects were thus produced, the light of the whirled tube being made to look like the white spokes of a wheel of glowing moonbeams. Then some rectangular tubes were taken and flashed or whirled so as to produce curious designs of luminous lines.

A bulb was shown by Mr. Tesla, said by him to be so highly exhausted that when the bulb was merely attached to one terminal of the disruptive discharge coil, it would send the sparks across the outside of the globe to the other terminal, which was on the opposite end, rather than pass through the bulb. The bulb in question was painted on one side with a phosporescent powder, or mixture, and threw a most dazzling light, far beyond that yielded by any ordinary phosphorescence. It was pointed out that there was no difficulty whatever in obtaining powerful phosphorescent effect in this way, and that a practical illuminant on these lines needed merely the perfection of the method of conversion above alluded to.

In conclusion, the lecturer made fine cotton-covered wires stretched on a frame over the table luminous, so that in the dark they looked like attenuated violet caterpillars yards long; and then, within a large rectangle formed by such wires, he flourished tubes in the interspace, these tubes flashing with light wherever waved.

After the lecture, so great was the desire of the public to see Mr. Tesla closer, an informal reception was held in the lobby, when several hundreds of the leading citizens seized the opportunity and Mr. Tesla's hand in a very vigorous manner.

It should be added that the Electrical Exchange, of St. Louis, presented Mr. Tesla at the beginning of the lecture with a magnificent floral shield, wrought in white carnations with a border of palms and American Beauty roses. It was about 4 feet in diameter. In the centre was a circle of red carnations bordering a tablet of white ones, bearing the letters in red $c = \frac{E}{R}$.

Around the circumference were the floral letters "St. Louis Electrical Exchange, 1893."

NEW PATENTS—1893.

4,793. "Improvements in the construction of the reel and battery box in connection with portable electric bells." J. O. BROOKE. Dated March 6th.

4,818. "Improvements in the construction of electric light switches and cut-outs." C. M. DORMAN and R. A. SMITH. Dated March 6th. (*Complete.*)

4,827. "An electric alarm for automatically signalling when lubricators are empty." J. POLLIT, E. WIGZELL, and G. MEDDINGS. Dated March 6th.

4,846. "Apparatus for submarine exploration, or for directing submarine operations at depths which have hitherto been inaccessible to divers." A. JOYCE. Dated March 6th. (*Complete.*)

4,869. "Improvements in the process of obtaining chlorates of the alkalies or of the alkaline earth metals by electrolysis." W. T. GIBBS and S. P. FRANCHOT. Dated March 7th. (*Complete.*)

4,871. "Improvements in electric batteries." N. ROLLAND. Dated March 7th.

4,874. "Improvements in the transforming and conversion of electric currents." H. F. FOSTER. Dated March 7th.

4,910. "An improvement in electric switches." E. L. JOSEPH and APPLETON, BURBEY, and WILLIAMSON. Dated March 7th. (*Complete.*)

4,911. "An improvement in contact makers for electric lamp holders." E. L. JOSEPH and APPLETON, BURBEY, AND WILLIAMSON. Dated March 7th. (*Complete.*)

4,912. "Improvements in the construction of spring buffer connections for the holders of electric lamps." E. L. JOSEPH and APPLETON, BURBEY, AND WILLIAMSON. Dated March 7th. (*Complete.*)

4,923. "Improvements in conductors in telescopic standard lamp holders for electric lamps." A. G. NEW. Dated March 7th. (*Complete.*)

4,938. "Improvements in incandescent electric lamps." G. S. RAM. Dated March 7th.

4,941. "Improvements in and relating to signalling on railways, and in telegraphic relays for use in connection therewith, and for ordinary telegraphic purposes." J. TUMA and E. VON MOTESICZKY. Dated March 7th.

4,952. "Improvements in electrical relays and measuring instruments." W. S. SMITH and W. P. GRANVILLE. Dated March 7th.

4,976. "Improved apparatus for working railway switches by means of electrical energy." SIEMENS BROTHERS AND CO., LIMITED. (Communicated by Messrs. Siemens & Halske, Germany.) Dated March 7th.

4,992. "Improvements in electric lamp sockets and like electric fittings." H. HIRST. Dated March 8th.

5,051. "Improvements in primary batteries." T. COAD. Dated March 8th.

5,064. "Improvements in electric clocks." J. CAUDERAY. Dated March 8th.

5,084. "An improved method for fastening electrical conductors, wires, cables, and the like in wood casings by means of adjustable clips or clamps." E. C. DAY. Dated March 9th.

5,101. "Improved system of electrically interlocking signals and points, and in apparatus therefor." G. E. FLETCHER. Dated March 9th.

5,109. "Improvements in and relating to the methods and means of coupling alternating current dynamo-electric machines in synchronal relation, and maintaining them in that relation." W. LOWRIE. Dated March 9th.

5,110. "Improvements in and relating to apparatus for charging electric accumulators." W. LOWRIE. Dated March 9th.

5,142. "Improvements in incandescent electric lamps, and in apparatus connected therewith." Sir C. S. FORBES, Bart. Dated March 9th.

5,143. "Improvements in microphones." Sir C. S. FORBES, Bart. Dated March 9th.

5,171. "An improved electric safety lamp." D. TOMMASI. Dated March 9th.

5,181. "An improved combined lamp and electrical igniting device therefor." J. LANG. Dated March 9th.

5,197. "Improvements in the production of alkali and in apparatus therefor, the said apparatus being applicable for electrolysis generally." J. HARGREAVES and T. BIRD. Dated March 10th.

5,198. "Improvements in and in making electrolytic apparatus." J. HARGREAVES and T. BIRD. Dated March 10th.

5,214. "Safety electric molten lock for miners' lamps." O. HAWKINS. Dated March 10th. (*Complete.*)

5,261. "Improvements in electric belts." R. D. BOWMAN. Dated March 10th.

5,271. "Improved apparatus for maintaining the tension of or

compensating for the expansion and contraction of signal or line wires." A. E. Berry. Dated March 11th.

5,286. "Improvements in the method of and apparatus for transmitting and reproducing sounds." T. Dedolph. Dated March 11th.

5,336. "Improved method of and means for fixing the 'lead' or conducting wires of electric incandescent lamps." E. Torrini. Dated March 11th.

5,337. "Improvements in conductors for electric railways." J. A. Ewing. Dated March 11th.

5,339. "Improvements in and relating to alternating current electric motors." R. Lundell and E. H. Johnson. Dated March 11th. (*Complete.*)

5,340. "Improvements in and relating to alternating current electric motors." R. Lundell and E. H. Johnson. Dated March 11th. (*Complete.*)

5,341. "Improvements in or connected with electric batteries." C. P. Shrewsbury, F. L. Marshall, J. Cooper, and J. L. Dobell. Dated March 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1891.

The Price of all Specifications (old and new) is now 8d. each.

5,790. "Improvements in incandescent electric lamps." E. Boehm and E. Bailey. Dated April 3rd. The lamp consists of a duplex ring or disc conductor of large sectional area and low resistance, or of one or more ring conductors coupled up in series or parallel. 3 claims.

11,108. "Improvements in and connected with electric primary batteries." T. Coad. Dated June 30th. Each cell is made separate, and a desired number cemented in a suitable holding case. On each side or inside of each cell a strip of carbon is cemented, against a platinum or other suitable stud for contact purposes. A spring arrangement may be put in the cover to press the zinc on the contact part.

11,526. "Improvements in and connected with portable electric lamps, and in primary batteries and lenses for deflecting light to be used therewith." F. G. W. J. Adams. Dated July 7th. The inventor forms the battery, which may comprise any required number of cells in one piece, by stamping or pressing its substance out of any suitable non-conducting material, but preferably out of India-rubber, when prepared for the purpose of vulcanisation and before vulcanising, and in like manner he forms, by moulding in one piece, the cover of suitable shape adapted to close the battery in such a way that the contents of the cells may be prevented from escaping. The detachable front is stamped out in a similar way, fitting in grooves or channels on back of the ridges or raised parts of the battery, and by which the connections are sealed or covered, and to which lamps, vases or other fittings may be attached. 9 claims.

11,630. "Improvements in and connected with moulds for manufacturing ribbed metallic plates, the said plates being more especially intended for use in electrical secondary batteries." A. S. Bower. Dated July 8th. Relates to improvements in means for manufacturing plates with parallel ribs and grooves on one or both sides thereof, the said ribs and grooves being generally of greater depth than width, necessitating peculiar mechanism whereby these ribs and grooves may be formed by casting. The improvements consist in constructing the moulds of matrices, and these may be formed out of a solid block by cutting therein slots of the proper width and depth. 3 claims.

15,407. "Improvements in galvanic batteries." G. Cohen. Dated September 11th. Claim:—A galvanic battery in which the exciting compound consists of a mixture of sal-ammoniac, calcii chloridum, powdered plaster or chalk and water, in suitable proportions substantially as described.

CORRESPONDENCE.

Economy in Using Incandescent Lamps.

In the article on "Economy of Using Incandescent Lamps" which appeared in your last issue, you observe that "Neither Dr. Böhm, nor several others who have written on this subject, take into account the fact that, although a lamp may start at 2·5 watts per candle-power, the efficiency soon runs down most deplorably, and at a much greater rate than those starting at a lower efficiency. Given lamps that do not alter appreciably on running at 2·5 watts per C.P. and that last an average of 300 hours, and we have nothing to say against the deductions arrived at by Dr. Böhm."

You also express the opinion that the average life of lamps running at the above-named efficiency, especially those of small candle-power and high E.M.F., is much less than 300 hours.

Had that article been written a year ago, I should have fully endorsed your opinion, as all my former experiments both in England, France, and Germany, and later at Zürich, from 1881—1892, have always confirmed my opinion that the average life of lamps of 2·5 per candle did not exceed 200 hours, and that even during the first 100 hours the rapid darkening of the bulb completely neutralised whatever gain there was in initial efficiency.

But in the course of some further experiments tried at Zürich about a year ago, I obtained a clue to the cause of this rapid change in the high temperature lamps.

In the experiments which followed, I found that it was not at all difficult to construct lamps that, during so short a period as 300 hours, should not blacken very materially.

Some of the trials with lamps made in this way were made at the station of the Cie Continentale Edison in Paris, and the results were given in the paper by Mons. C. Haubtmann in *L'Electricien* of September 24th, 1892.

It will be seen, by reference to that paper, that the lamps of 12 candles had in 300 hours only changed in C.P. from 12·9 to 11·7, while the efficiency had only changed from 2·65 to 2·69.

In the 16-candle lamps the efficiency had changed from 2·73 to 2·75 in 250 hours, and the candle-power from 17·62 to 16·65.

The average life of the 12-candle lamps in this trial was 300 hours, and the 16-C.P. 600 hours.

Lamps of this kind, therefore, fulfilled the conditions required, of an average of 300 hours, without material reduction of efficiency.

But on further pursuing the matter I have been satisfied that a much longer life than an average of 300 hours can be attained at efficiencies of from 2·5 to 2·7 watts per candle, and that with lamps of 8 and 10 candles at voltages of 110 to 115.

The results of the trials conducted at central stations in various parts of the Continent have only as yet been partly received, but there is already abundant evidence that a mean duration of at least 500 hours can be safely relied on, and with a loss of candle-power of not more than 20 per cent. with lamps having an initial efficiency of 2·5 to 2·7 watts per candle.

The actual results received up to the present time show a much smaller loss of light than that I have mentioned, and there is reason to hope that it may not exceed 12 per cent. in the 500 hours.

Many of the trials show no diminution of light at these high temperatures during 100 hours; in one account the efficiency has changed from 2·5 to 2·6 watts per candle in 300 hours.

I think that there is no longer any doubt that a real economy in electric lighting can now be effected, and that without any serious sacrifice of the average illuminating power of the lamps during a period of 500 hours.

At the average price of 7d. per unit, which is charged in London for current, the difference per 16-candle lamp per annum between 4 watts and 2·7 watts amounts to no less than 18s. (taking 1,500 hours as an average year's lighting).

It is obvious how very important a matter the suppression of the 4-watt lamp is to the ordinary consumer who pays by meter.

C. H. Stearn.

Zürich, *March 19th*, 1893.

Dynamo Forgings.

Seeing your invitation in a back issue for any information on the above subject, perhaps the following might interest you.

I have been recently getting very pure iron from steel makers by Martin Siemens and Basic process. The pig iron has all the impurities burnt out of it, and remains in the converter almost pure iron. Some small additions are made to it by the chemist while in the converter; the result is iron much softer and purer than iron made by the old puddling process.

Should any of your readers wish, I shall be most happy to send small sample, that electrical and magnetic tests may be made on it. So far it has given great satisfaction to the dynamo makers who have tried it.

Jas. Muirhead.